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ELECTRICAL REVIEW.

VOL. LXXXVI. JANUARY 16, 1920. No. 2,199.

ELECTRICAL REVIEW.

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THE PRICE OF THE "ELECTRICAL REVIEW."

During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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A RED RAG TO JOHN BULL.

FOR a long time past it has been obvious to everybody interested in export trade matters that, though we and our American Allies worked together as one people in order to win the war, that spirit of unity would be in danger of extinction when we settled down to the operations attending post-war trade competition. To the idealist it may seem a thousand pities that it should be so, and even to average commercial minds it may appear that the world-need for manufactures is so great that for a time, at any rate, there will be enough for all to do without indulging in big talk reviving former asperities and causing irritation to those easily influenced by such things. Personally, we have become so accustomed to the extravagant statements of ambitious advocates in other countries, European and otherwise, as to their lick-creation intentions, that we decline to quake at the utterance thereof. In this, we confess to something in common with the President of the Board of Trade, who declines to "shiver" at the prospect of foreign competition. Foreign competition is going to be keen—there is no doubt about that, and it seems certain that, sooner or later, British manufacturers, if they have the support of the workers, are going to do their part to make it so. Have not our industrial organisations been preparing for a long time, so that they might be equal to the attack when it came? And are they not preparing also to deliver attack when the situation requires it? Yet though there is this preparation proceeding in many countries, it seems to us that it might be a little more gracious on the part of some people if, in these early days, they were a little less aggressive. We recognise that in all nations there will always be some who will be unable to refrain from dreams of exercising world-power commercially. Sometimes, as in Germany during certain stages of the downfall of Prussian Militarism, statements designed to make our British blood run cold were made by men whose idols now lie broken into fragments. Much of this sort of thing was mere camouflage to hide the fear that they were losing. Is it likely that we shall be upset by what we will call the bad taste of some of our prosperous trans-Atlantic industrial friends?

We are not concerned, in making these remarks, with the world schemes of United States electrical export organisations that have been established to satisfy some of the general hunger for electrical manufactures, for we have not come across tactless speeches from these sources expressive of world-power intentions. We are touching the subject now because correspondents in New Zealand are showing signs of anger at the utterances of a certain Mr. Montague, who "bears the discredit of having framed" the "Webb-Pomerene Act passed by the U.S. Legislature" in 1918. This Act, to which we alluded at the time, was intended to exempt American foreign trade combinations from the provisions of the Anti-Trust Legislation of the U.S. Mr. Montague has been addressing certain textile authorities, textile traders having decided to avail themselves of the Act and put up £4,000,000 to "carry on." Nobody can object to that, even if it does, as a New Zealand paper says, enable them to employ "all the iniquitous dodges conceived by the most scoundrelly of trust magnates, and which would place them behind prison bars if attempted in their own country . . . . in an endeavour to throttle competition." It is a game that two, or three, or even twenty, can play if they are so minded—deplorable as it seems after we have fought side by side for higher purposes on the battlefields of Europe. What we do take mild exception to, is such talk as this from Mr. Montague, or any other American world-power hot-head:—

"We have provided the machinery by which the whole of the energy, the wealth, and the brains of each American industry, will co-operate to crush down foreign opposition in foreign markets, and secure those markets in their entirety for American manufacturers."

If this were the first time we had heard this sort of thing, we *might* have to think whether to obey the popular demand "Hands up!" while the brigand bagged the booty. As it is, however, we prefer to order pistols for two—that is more like the British way. Mark the hurry and hustle of this American booster! Fancy the American trade being deprived of *all the energy* and *wealth*, and even the *brains* too, now required to run its Home industries, because they are to be diverted to crush out a few poor innocent, helpless, stupid foreign worms "in their entirety." And after that? "We will tack the cost of it all on to the price," and make the "foreigner" pay, said one, Steenbohm by name.

Shall we be pardoned for daring to remember that our trans-Atlantic cousins got into our markets, and became prosperous right there, while we were at death-grips exhausting Germany? Can it be that something has disappointed those of whom Mr. Montague and Mr. Steenbohm are representative? Is the outlook not so promising as they expected it to be? Are the stars in their courses not leading all the buyers of the world in the right direction? Without waiting to witness the blush of shame—or pride—on the cheek of Brother Jonathan, let us hasten to credit our splendid Ally with a desire to continue to dwell in normal harmonious commercial rivalry with other peoples—Peace Treaty or no Peace Treaty—and let us regard Mr. Montague's outburst as an exceptional, but, perhaps, inevitable, pleasantry heralding the beginning of the biggest trade war the world has ever seen.

Manufacturing Costing Systems.

In his recent paper before the Institution of Electrical Engineers on "Scientific Management," Capt. Scott Maxwell drew attention to efficient costing systems as an essential feature of scientific management. The point, however, did not receive much attention in the discussion, perhaps for the reason that the author himself asked that principles should be concentrated upon by the various speakers, rather than details. The importance of efficient costing systems and staffs, however, is emphasised by the inauguration of the Institute of Costs and Works Accountants. This is not a Trade Union, but an addition to technical societies of considerable importance to the engineering and other industries, for it is its object to promote the higher efficiency of those engaged as works accountants in order to render them more valuable to their employers. In spite of all that has been said and done with regard to scientific management, there is evidence that the importance of the position of works accountant is too often under-estimated in relation to its value in assisting the management in framing its policy. Moreover, it is not recognised as fully as it should be that costing is an intricate and costly business, which needs some knowledge of the particular industry in order effectively to carry it out. Many firms have formulated new ideas on this question as the result of experience gained during the war, when costing had to be approached from quite a different angle to that which was followed previously, and these firms are not likely in future to hand the work of costing over to any clerk, as is even now too often the case. The engineering trades may well investigate what the printing trade has done in this connection. Several years before the war it was found that the costing system in the printing trade was more or less in a hopeless muddle, and some of the leading firms got together and formulated a costing system which has now been standardised to such an extent, that it is claimed it can be applied to any business, whether the number of employés be three or three thousand. Obviously the primary function of the works and costs accountant is to provide the works manager or the managing director, or both, with periodical figures of the cost of the various products in the firm's programme, in order to assist in the formulation of a policy. Indeed, the works accountant should be looked to for advice in interpreting what his figures purport to show. Looked at from this point of view, it will be seen how separate and distinct are the works accountant and the chartered accountant, yet this is not always appreciated, for the so-called works accountant, if he goes by such a name, is too often expected to work under the direction of the chartered accountant, who merely comes in half-yearly or yearly, for audit purposes. Moreover, the experience of many firms during the war was that even chartered accountants are not always *au fait* with the intricacies of works costing in its highly-developed state, for many were the disputes with the Government chartered accountants concerning the ever-vexed problem of overhead charges. There is, too, a certain irony in the fact that in America, the reputed home of scientific management, there was even greater trouble than here between the Government chartered accountants and firms working on Government contracts on these questions of the proper allocation of costs in arriving at total costs for the purpose of adding the agreed rate of profit. Perhaps, however, it would be unfair to lay these difficulties too much at the door of the chartered accountants and to overlook altogether the idiosyncracies of the other side, which may reasonably be suspected of indulging in a little leg pulling, in order to run up the costs, and, consequently, the profit. However, looked at from the purely commercial point of view, no firm with any pretensions to scientific management can expect to reach the highest state of efficiency without a sound works accountant, a man who knows something of the technical side of the business he is engaged in, and who can offer advice which can be relied upon. So much for the position of works accountant. The question of the system to be adopted is equally important, and in the engineering trades at the present time there is need for co-ordination and standardisation. This is one of the planks of the new Institute, which is out to deal with industry by industry in an endeavour to introduce some degree of standardisation, in so far as it is not affected by peculiar local circumstances. We have the example of the printing trade before us, and a large field for work lies before those who have undertaken this task.

Electricity Supply.

It is unfortunate that writers in the lay Press on technical subjects often do not take the trouble to make sure of their facts before they plunge into the ink-pot. We have on many occasions pointed out the injury that may result from the erroneous impressions thus conveyed to the public mind, but examples continue to multiply. For instance, in *The Times Trade Supplement* a contributor states that the Electricity (Supply) Bill was divided into two parts: the first part gave complete autonomy to the existing undertakers, while the second took it away from them, and also deprived them of the ownership of the generating stations. The former has become an Act; the latter, it is stated, will be reintroduced next session, and "autonomy will be cut short the moment the new Bill becomes (if it ever should become) an Act." We recently explained at some length that this was not a true statement of the facts. Certainly the first part is more or less true; undertakers have a free hand to co-operate in the formation of joint electricity authorities, on which they will have direct representation. But to say that "autonomy will be cut short" in the event of the new Bill being passed, is incorrect; such joint authorities as are then already formed will be practically unaffected by the new Act, and the way will still be open for others to be formed, with the additional incentive of the sword of Damocles hanging over the parties, lest they should prove reluctant, or unable, to enter into co-operative arrangements by voluntary action. We agree, of course, that it is very urgently desirable that undertakers should "get busy" as quickly as possible with joint schemes; it is far better to do so voluntarily than under compulsion. But we repeat that, even had the whole Bill become an Act, the door would still have been open for companies to enter into arrangements with other undertakers, and to dispose of their plant to the joint electricity authorities by agreement, without coming under the "standard price" clause at all.

Industrial Organisation.

AT the end of October last there was published, under the auspices of the Garton Foundation, a most interesting pamphlet of considerable importance in the present position of the world of industry. It is called "The Industrial Council for the Building Industry," and purports to contain what is described as "the story of a revolution in industrial development," together with the full text of the Foster Report on "Organised Public Service in the Building Industry."

It is to be hoped that this well-written pamphlet, of 153 pages, published at the modest price of 1s., will be widely read. It will afford leading to those who hope for a real change of heart on the part of both employers and employed, and encouragement to those who are groping towards the light; while even those (and they exist on both sides) who believe in coercion and industrial war as affording the only path to improvement cannot fail to be impressed by the results which have already been achieved, and the greater advances which appear probable in the immediate future.

The inaugural meeting of the Industrial Council for the Building Industry (Building Trades Parliament) took place at the Central Hall, Westminster, on May 29th and 30th, 1918. Thus it was established before any of the Whitley Committees or Councils, and, indeed the whole conception of the scheme was bigger, better, and earlier than Whitleyism.

The spirit of aggression and stubborn resistance, the advocacy of coercion, and the preaching of open enmity between employers and employed, had reached a point in 1914 at which the smallest spark might cause a disastrous explosion. The employment of two non-Union electricians at the new offices then being built for the Pearl Assurance Co., in Holborn, brought out all the Trade Unionists engaged on that contract. The Board of Trade arbitrator pronounced against the Unions, and the strike began. A national lock-out of all building trade operatives would have been commenced on August 15th of that year, but for another and infinitely greater and more terrible conflict.

A young man, named Malcolm Sparkes, who was then a director of a large joinery works near Willesden, was one of those who had been drawn into the dispute, and he was moved thereby to try to discover, in his words, "a solution big enough to break through the old barriers of hostility and suspicion, and carry all before it." For 18 months the only concrete result was an unnoticed paper read before a group of friends, who were all keen social students, but when, in February, 1916, the Unions in the London building industry presented fresh demands, and gave notice to terminate their truce with the employers, Mr. Sparkes took the bold course of writing to the secretary of the Amalgamated Society of Carpenters and Joiners, and suggested, in plain terms, the setting up of a National Industrial Parliament for the building industry. The keynote was to be public service. All were to unite their efforts, and endeavour to organise the industry so as to serve this end in the completest possible way.

The Trade Unions concerned discussed the matter, and eventually made a definite proposition to the National Federation of Building Trades Employers of Great Britain and Ireland, in a letter dated January 17th, 1917. How that letter brought about meetings, negotiations, and discussions, which led finally to the establishment of the Building Trades Parliament, should be read in the pamphlet now under consideration. It will be found an enthralling story.

Mr. Sparkes had published an article on the Industrial Parliament scheme in *The Venturer* for December, 1916, which attracted the attention of the Right Hon. J. H. Whitley, M.P., and caused him to request the author to prepare a special "Memorandum on Industrial Self-Government," which reached the printers on January 28th, 1917.

The scheme was earlier than the Whitley scheme. Bigger ideas went to its making. It was, and is, free from the defect we have so often pointed out in these columns—the defect of ignoring the trained technical worker. He finds his right place in the Building Trades Parliament. If you want to know how, read the pamphlet.

It is a great pity that the shop stewards' movement in the engineering industry seems to be based on organised antagonism. By continually encroaching on the control, first of the workshop, then of the factory, and, finally, of the administration and costing, the workers hope to eliminate the capitalist employer. The pamphlet states that the Industrial Parliament has, on the other hand, been described as organised voluntaryism (barbarous word—why not "voluntarism"?). Surely this is the better method.

The ground covered by the Foster Report is immense. The report deals with subjects upon which we have commented on other occasions, and in connection with other interests; as, for instance, the maintenance of constancy of employment by the regularisation of demand, and the conditions of entry into the industry. The decasualisation of labour, and the provision of work in other directions when actual building could not absorb all the workers available—afforestation, preparation of sites, demolition of condemned slums—receives careful attention. Research, education, remuneration of the management, and the hiring of capital are all dealt with, and the Committee's conclusions provide much food for thought. The vexed question of scientific management, by some thought to be closely allied to nigger-driving, is touched upon; and in general this Committee, composed of eight employers and eight operatives, got right away from the idea of restriction of output, and showed that the way to progress is for everyone to do just the best of which he or she is capable.

"To See Oorsels."

THE prime motive of the "Informal Meetings" of the Institution of Electrical Engineers is, we believe, to encourage the more diffident—or the less self-assertive—of the members to practise the art of debate, with the comfortable consciousness that their remarks will not appear in cold print. That is an excellent arrangement, and has been justified by the success of the meetings, though the principle has not always been strictly observed by some of our contemporaries. We have already drawn attention to the peculiar choice of subjects for the informal meetings of the current session, which would appear to indicate the presence of an undue proportion of the journalistic element on the Managing Committee, with a morbid propensity for "talking shop"; how else can we explain the choice of "Engineering Advertising" for one meeting, and "The Functions of a Trade Journal" for another? Perhaps the title of the former subject, in spite of the principle to which we have referred, contains the solution of the mystery.

However, that is by the way; the subject is chosen, and on Monday next we shall sit at the feet of Gamaliel and receive instruction as to the place in the cosmos that we are expected to fill. Are we to appear before the Court of Public Opinion as witnesses, defendants, or, perhaps, co-respondents? or shall we merely occupy the congenial *rôle* of students? Like Councillor Kelly, at the M.T.A. Conference, we are tempted to ask: "Where do we stand?"

Fortunately we have a clear conscience, and even if we have ventured to open our columns to articles on the commercial value of "The Engineer's Wife," and the converse question—the commercial value to his wife of the engineer—we have committed no breach of decorum in the handling of those delicate subjects.

For the rest, assuming that we are in the witness-box, our proof of evidence is simple and concise: The functions of a trade journal are to collect and distribute news and information, technical, social, and commercial, bearing upon the industries concerned; to provide a medium for the interchange of views and the solution of industrial problems; to make known to the world the products and achievements of British manufacturers and engineers; to protect the public against the wiles of knaves and the illusions of the ignorant; and generally to promote the welfare of every branch and section of the industry concerned by every possible means.

Those are the main functions of a trade journal as we understand them; there are many minor ones that we could cite, but we are not writing a paper—no doubt they will receive attention at the meeting.

THE ELECTRIFICATION OF THE MELBOURNE SUBURBAN RAILWAYS.

(*Concluded from page* 40.)

Rolling Stock.—The trains are operated on the "multiple unit" system, under which, instead of employing locomotives, every second or third car is equipped with motors; the weight of these cars is thus available for adhesion purposes. A complete train (fig. 8) is made up of a number of motor-cars and trailers, easily varied to suit the changing conditions of traffic.

In the case of Melbourne, while it was at one time intended to make up each "unit" of a motor-car and a trailer, both equipped for driving from one end, only a limited number of trailer cars have, for the present, been equipped with driving apparatus. The normal six-car train has a motor-car at each end, with a third motor-car at the centre of the train. No special type of car has been designed for Melbourne, the existing rolling stock being as a rule utilised. Some 45 per cent. of the rolling stock will consist of compartment cars with swing doors, the remainder being of a combination type, having sliding doors and cross-seats, with a corridor.

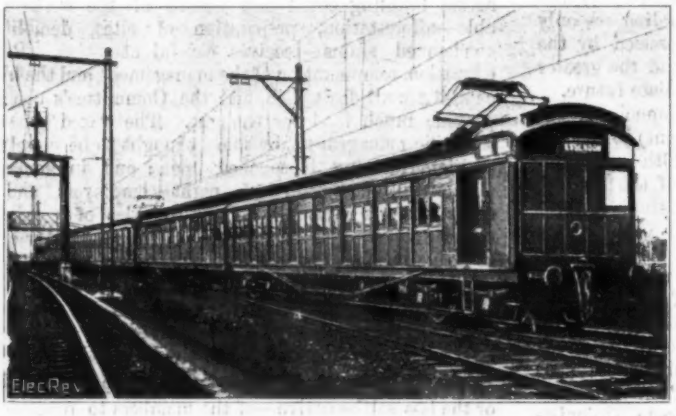


FIG. 8.—SIX-CAR SLIDING-DOOR TYPE TRAIN.

As no new swing-door cars are being constructed for the electric lines, the bodies of the existing cars are being transferred to new underframes and bogies of a type uniform with those used in the sliding-door cars. Some of the sliding-door trailer cars have also been running in the steam service, but new sliding-door motor-cars are being constructed for the electric service. The swing-door cars are very similar to those used on British railways. The sliding-door cars have a centre passage-way throughout, but no vestibule, so that it is not possible for passengers to pass from one car to another. The whole of the rolling stock was built in the State Railway workshops at Newport.

Each motor-car has four motors of 140 H.P., the gear ratio being so proportioned that the maximum speed will be 52 M.P.H. on level tangent track. They are of the G.E. 237 type, normally for 750 volts.

The total pressure of the pantograph on the contact wire is such that, with a reasonably clean wire, the pantograph is able to collect considerably over 500 amperes, which is the normal maximum operating current for each motor coach, without sparking, from a contact wire of 0·25 sq. in. cross-section. The pantograph has a working range between 14 ft. 6 in. and 21 ft. 6 in., the working pressure being maintained by means of springs. It is brought into and taken out of action by pistons in cylinders mounted on the frame of the collector, fig. 9. Air pressure for the initial operation of the pistons is supplied, in the first instance, by a hand-pump installed in the guard's compartment; the motor pumps can then be started up, and the subsequent air pressure obtained from the main brake reservoir. The pantograph is then controlled by means of two electro-pneumatic valves operated electrically or by hand.

In order to reduce the line voltage to one suitable for the master-controller and other control circuits, a dynamotor is used consisting of a single field, and an armature with two identical armature windings and commutators.

The master-controller is of standard type, but as the actuation of the contactors is automatic, the controller only has four points in the forward direction and two in the reverse direction. The air compressor, governor, emergency and trip valves are of the usual type.

Permanent Way.—The system consists of approximately 335 track miles, including sidings; most of the routes are double track, but those from South Yara to Caulfield, and North Melbourne to South Kensington, are four-track routes, while for three miles there is a six-track route. The normal permanent way construction is 100 lb. per yard, T-section rail double spiked to untreated sleepers of hard wood, there being about 15 in. of bluestone ballast. The track gauge is 5 ft. 3 in., with 11 ft. 8 in. centres, while minimum structure clearance above platform level on tangent track is 7 ft. from track centre, increased to 8 ft. on 12-chain curves. The minimum curve is of 9 chains radius, while the maximum grade of any importance is one of 2 per cent. For nine miles the average grade is 0·85 per cent., the maximum permissible speed on this section being 52 M.P.H. Practically all curves have a 150-ft. easement approach.

Overhead Equipment.—The equipment of the track with overhead contact wires for operation at 1,500 volts was designed to provide the advantages of a flexible construction which would secure the best conditions for current collection by the pantographs on the trains and to maintain the total copper section required per track without auxiliary feeder cables. The number of conductors was kept at a minimum in order to avoid interference with signals, only one catenary wire and one contact wire being employed over each track, fig. 10. The supporting droppers between the catenary cable and contact wire are terminated at the lower end by a short length of chain, so that the tendency of the contact wires to lift under the

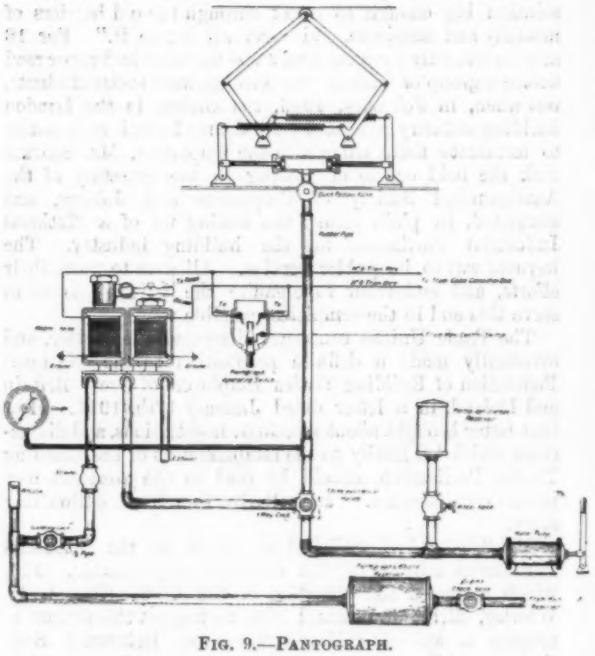
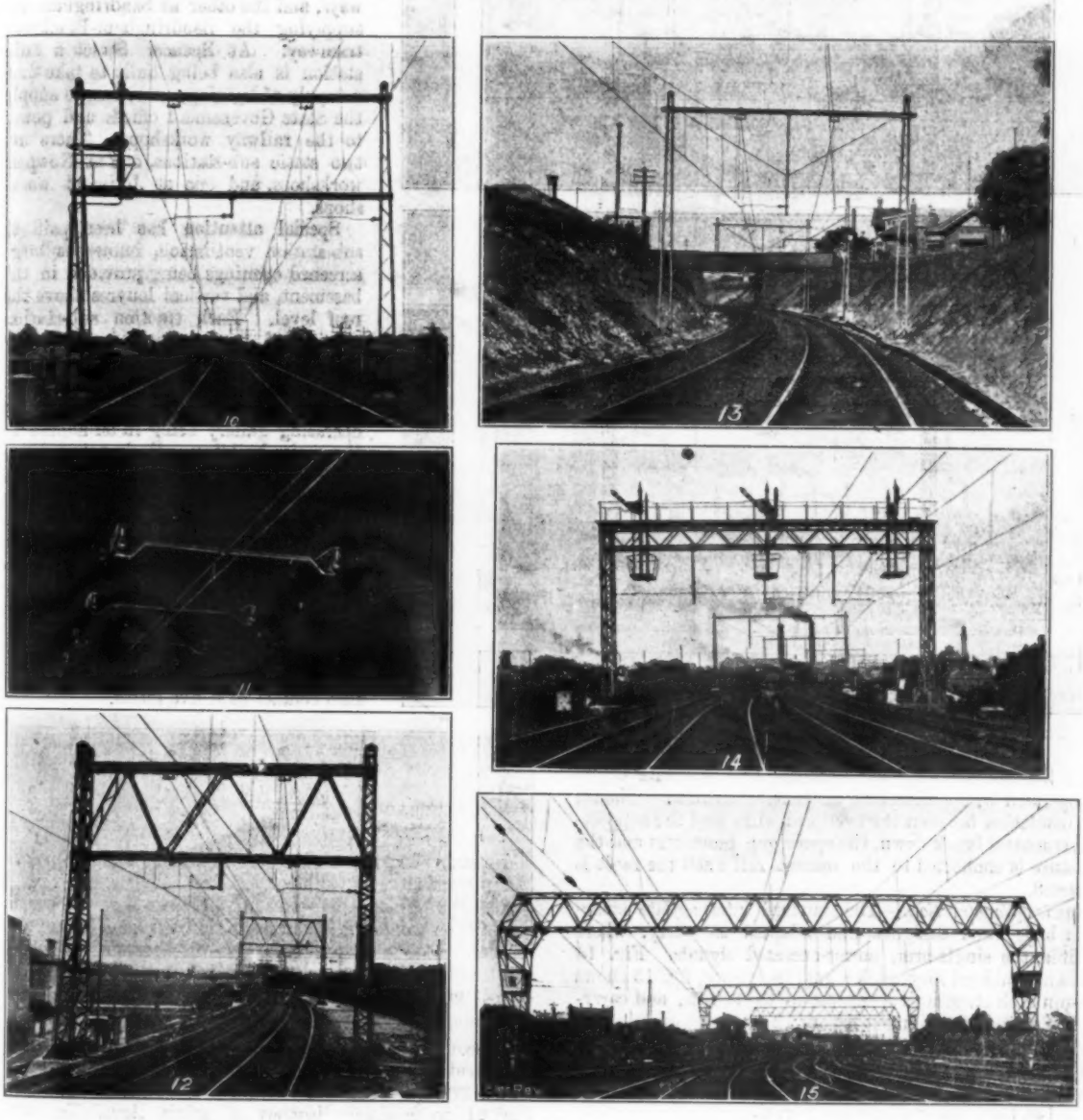


FIG. 9.—PANTOGRAPH.

upward pressure of passing pantographs is not restricted by the weight of the dropper or of the catenary cable to which it is attached at the upper end.

The normal construction on main suburban tracks provides for 0·25-sq. in. hard-drawn, grooved copper contact wire, supported by flexible droppers at intervals of 15 ft. from a stranded hard-drawn copper cable of 0·25 or 0·375 sq. in. There is thus a minimum equivalent of 0·5-sq. in. section of copper over each track. The contact wire is automatically tensioned at each end of each 3,000-ft. length to approximately 2,500 lb., and is anchored near the centre of every such length. The catenary wire normally has a 10 ft. 9 in. sag at the centre of a 300-ft. span at 60° F., with a minimum tension of approximately 3,200 lb.

The normal contact-wire height is 16 ft. 6 in. over the main suburban tracks at 70° F., but over grade crossings the minimum height is 18 ft., while under low bridges, which are numerous, the minimum height is 14 ft. 6 in. above rail level, giving a vertical clearance of 12 in. between the contact-wire collecting surface and the underside of bridge. As the maximum height of the projecting ventilators on the country rolling stock is 14 ft. 2 in., considerable care had to be exercised in erection to preserve the clearances provided. The standard contact-wire suspension is maintained, but beneath low bridges, fig. 11, and to ensure that the pantograph would not raise the contact wire more than 2 in., a maximum grade of 1 in 150 was adopted for the line, and, where possible, a grade of 1 in 250, except where speeds were limited. In some cases rigid droppers have also been used. The dropper connections between the catenary and contact wires were measured and cut to a special dropper table, which provides the necessary adjustments to allow for grades; the droppers were then erected on the field with practically no adjustment, and a well aligned line has been obtained, whose vertical movement responds uniformly to changes of temperature, the catenary wire being stressed well within its elastic limit to provide for this. The importance of this precaution will be realised with temperature limits between 27° F. and 175° F. Where a steam service is also being used, the insulators are arranged so as to avoid the direct blast of the locomotive exhaust.



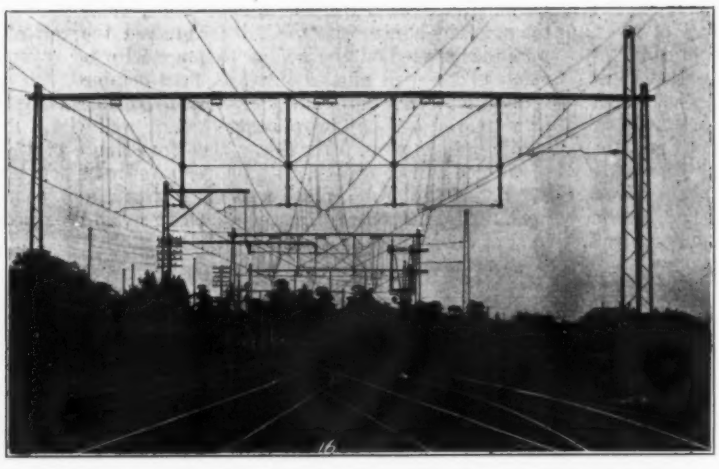
FIGS. 10 TO 15.—OVERHEAD STRUCTURES.

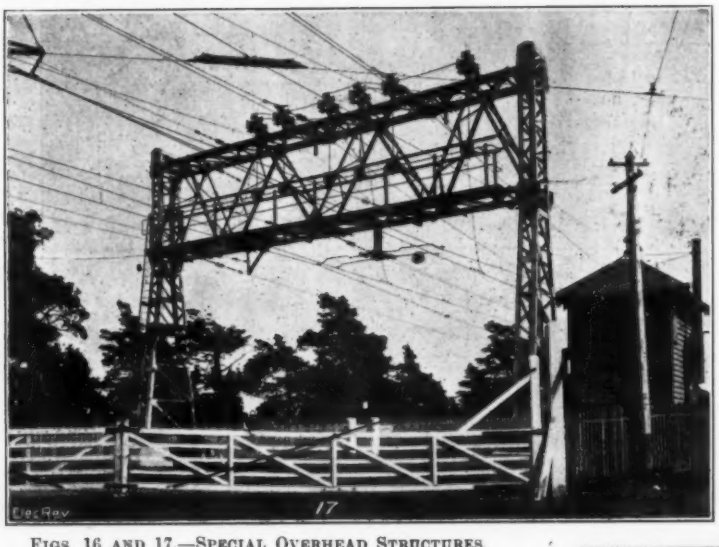
The whole of the fittings were specially designed for the equipments by the consulting engineers in conjunction with the contractors.

Supporting Structures.—The supports for the catenary construction consist of pairs of tensioning anchor structures, fig. 12, about 3,000 ft. apart with light intermediate structures at 300-ft. intervals on the straight track, and closer on curves. Fig. 13 shows the supporting structures on a curve.

Earthing.—All overhead equipment structures, signalling bridges, and overline road bridges to which line work is attached are bonded to the track rails through a paper spark

gap 0·001 in. thick, between two aluminium disks, so that they are normally insulated from the rails. This is necessary to limit the unbalancing of current through the impedance bonds connecting the signalling track circuits which are operated by superimposed alternating current. Should the insulation between the overhead wires and the supporting structures break down, the spark gap punctures and the structure is connected to the nearest rail until the fault is corrected.





Figs. 16 and 17.—Special Overhead Structures.

Special Construction.—The standard intermediate structures have been designed and adapted to carry, where possible, the single-arm, power-operated signals. Fig. 14 shows a combined four-track signal structure, fig. 15 shows five-pin arch structures spanning up to 120 ft., and carrying the overhead equipment load of 13 tracks on an 18-chain curve. They are also designed to carry a distributed signal load of about six tons. Figs. 16 and 17 give a good idea of special wiring, it being noted that no contact wires are crossed at the pantograph running level.

Sectioning and Insulation.—The up and down tracks of all routes can be electrically insulated from each other, and all routes are as far as possible separately fed. At extensive junctions the overhead wires of a number of tracks are connected together, and treated as one section, and are usually tensioned at both ends. An air section insulator is employed between track sections where the speed of trains exceeds 25 m.p.h. Over cross-overs and leading-in tracks to sidings where train speed is restricted, the tracks are electrically insulated from each other by means of section insulators in the catenary and contact wires.

Sectioning points are located with reference to traffic requirements and the position of cross-overs, being on the out-lying lines from 2 to 3 miles apart. The system as a whole is divided into sections which extend beyond sub-stations, and which are divided into sub-sections, while sidings and terminal tracks leading from the sub-sections are divided into branch sections. There is a very complete system of track-circuiting and electric signalling. On the ends of the sleepers opposite "stop" signals are installed automatic train stops (fig. 18) operated through gearing by small induction motors.

Sub-Stations.—The positions of the sub-stations are shown in fig. 19. Fifteen railway traction sub-stations are being provided, and there are in addition two tramway sub-stations, one at Elwood for supplying the St. Kilda-Brighton tramways, and the other at Sandringham for supplying the Sandringham-Blackrock tramway. At Spencer Street a sub-station is also being built to take over a supply of lighting, as well as to supply the State Government offices and power to the railway workshops. There are two static sub-stations, one at Newport workshops, and one at Jolimont workshops.

Special attention has been paid to sub-station ventilation, numerous large screened openings being provided in the basement, and vertical louvres above the roof level. Each traction sub-station consists of two or more bays for the rotaries, with an unloading bay, and the larger sub-stations have a bay for signalling equipment, the switch house and operating gallery being in an annexe to the main building. Each rotary is installed in a separate compartment, so that during the starting up and operation of any particular rotary, the chamber is screened off, the locking gear on the entrance gate being inter-connected with the 20,000-volt switches controlling the supply to the rotary static transformers, and also with the operating levers controlling the 1,500-volt d.c. gear, so that it is impossible for an operator to come into contact with live metal.

Fig. 18.—Automatic Train Stop.

H.T. Switchgear.—The 20,000-volt switchgear is of the cellular type; the cell doors are completely interlocked

with the main oil switches and isolating switches, so that access cannot be obtained to live conductors. The switchgear is arranged on three floors. On the ground floor are

Fig. 19.—Map of Melbourne Suburban Railway System.

installed the cable terminal boxes, earthing and isolating switches, and instrument transformers; on the first floor are installed the oil switches, which are of large breaking

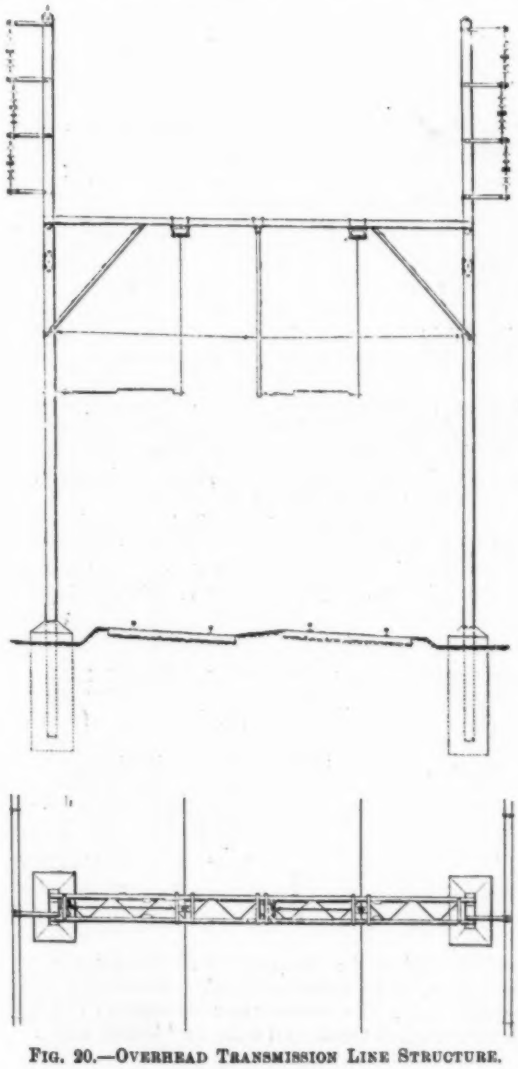


Fig. 20.—Overhead Transmission Line Structure.

capacity, each unit consisting of three single-phase switches in strong steel tanks. The whole connections in the oil-switch cell are insulated, and the doors to the cell are dust tight. The gallery giving access to the switch cells is open to the outer air, so that in the event of a fire occurring in one-switch cell, it can be dealt with from the outside. The oil-switch tanks are provided with vent pipes which discharge the gases into the open gallery; on the second floor are the busbars and busbar isolating switches. The busbars are split by means of a section switch, so that maintenance work and repairs can be carried out without shutting down the whole of the substation. The operating gear for the 20,000-volt and isolating switches is on the operating gallery, fig. 21, in front of the oil-switch cells.

D. C. Traction Switchgear.—The 1,500-volt D.C. switchgear and the positive busbar are installed on the ground floor below the operating gallery, and all isolating switches and circuit-breakers are operated by signal levers from the operating gallery above. The switchgear is mounted in cells with the automatic circuit-breakers on the top. The chamber containing the switchgear and circuit-breakers is specially ventilated. The negative and equaliser busbars are run in the basement below the rotary converters.

Signalling Switchgear.—The 2,200-volt, single-phase signalling switchgear is of the Reyrolle armour-clad type, specially developed for the purpose. It is installed on the operating gallery.

Fig. 21.—Substation Operating Gallery.

Auxiliary Switchgear.—The 440-volt switchgear for controlling the auxiliary and signalling supplies is of the Metropolitan-Vickers ironclad type, and is mounted on the gallery above the auxiliary transformers, in one bay of the main building. The 110-volt D.C. switchgear for controlling the lighting motor-generators, the tripping and operating battery, &c., is of the usual slate-panel type, and is mounted on the operating gallery.

Rotary Converters.—Four sizes of rotary converter are at present being built by Siemens Bros. Dynamo Works, Ltd., Metropolitan-Vickers Electrical Co., Ltd., and by the General Electric Co. (of New York), the two-hour ratings being 3,000 KW., 2,250 KW., 1,500 KW., and 750 KW. The 750-KW. machines being destined for installation in outlying sub-stations, with a comparatively infrequent train service, have been specially designed with a drooping characteristic, since the overloads are relatively more severe, and the regulation of less importance. The conditions laid down were the conversion of three-phase energy at 19,000 volts, 25 cycles to direct current at 1,500 volts, with a leading power factor of 0·95 at normal load. A compound winding on the larger machines compensates for a drop in pressure of 10 per cent. at double full load. The machines are six-phase with 12, 6, or 4 poles, and are arranged for self-synchronising. The 3,000-KW. machines are designed to

carry 6,000 KW. for short periods, and *pro rata* in the case of the other sizes, except in that of the 750-KW. machines, which are designed to carry 2,000 KW. for short periods.

H.T. Distribution System.—Thirteen 20,000-volt feeders radiating from the Newport power house to the sub-stations in the central area are included in the present scheme, nine being of 0·15 sq. in. and four of 1 sq. in. C.S.A. Paper-insulated, lead-covered, wire-armoured cables are employed, all of the split-conductor type. The cables are mainly laid in trenches in the streets, owing to the very limited space available alongside the railway lines. The trench averages 4 ft. in depth, and the cables are 1 ft. 9 in. between centres, covered by boards; special precautions are taken in the cast-iron joint boxes (fig. 22) to prevent air pockets being formed when being filled with compound.

In the outlying districts the supply to the sub-stations is provided by overhead transmission on the track equipment structures. The overhead transmission lines are carried on brackets (fig. 20) extending from the sides of the masts away from the tracks, the three phases, each of two separate wires of 0·035 sq. in. C.S.A., being placed directly above one another, and supported on chain-type insulators. This enables the split-conductor protection system to be employed throughout the E.H.T. transmission system. Telephone cables are laid along the route of the 20,000-volt transmission line, there being an automatic telephone exchange at Jolimont sub-station for 50 lines. This provides communication between the control room, all sub-stations, and certain important signal boxes from which switching of the overhead contact wires is regulated. Such 1,500-volt D.C. feeders as are employed are paper insulated, lead covered, and for the most part wire armoured, being of 0·75 sq. in., and in a few cases 0·5 sq. in. sectional area.

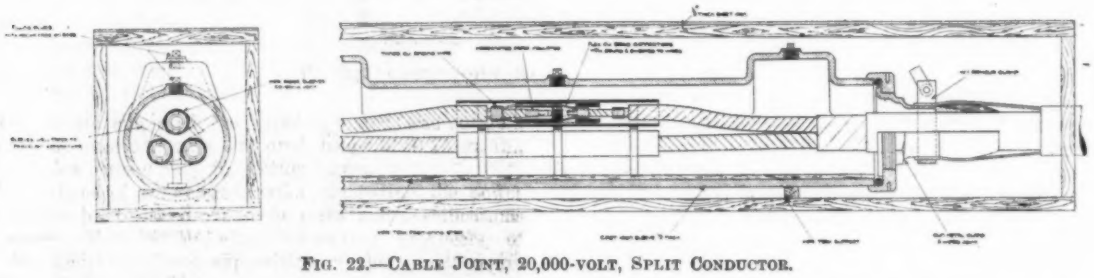


FIG. 22.—CABLE JOINT, 20,000-VOLT, SPLIT CONDUCTOR.

The whole of the electrification, including the power station, has been carried out to the plans and specifications of Messrs. Merz & McLellan, consulting engineers, of London, under the direct supervision of their local representative, Mr. E. P. Grove, at their Melbourne offices, in conjunction with the Electrification Committee of the Railways Department. The excavations, foundations, plaster walls, and brick buildings, were carried out by the Victorian Railways staff.

For some of our illustrations we are indebted to *The Commonwealth Engineer*.

We are informed by our Australian correspondent that Mr. C. H. Merz visited Melbourne in October last, having gone on from South Africa. He was to inspect the electrification work and advise the Railway Department if the undertaking could be expedited.

Fuse Size for Mercury-Arc Rectifiers.—On account of the high starting current required by mercury-arc rectifiers, some trouble is occasionally experienced in determining the correct size of fuse to use. If the rating is too high, the tube will not be adequately protected against overloads and its life will consequently be shortened. On the other hand, if the fuse is rated too low, there will be a tendency to blow if the tube is cold and requires a greater amount of current. Mr. H. E. Weightman, writing to the *Electrical World*, states that he has found that if the fuse is rated at the value obtained by the use of the following formula, proper protection will be afforded :—

$$I = (1{\cdot}5 \times W) / E \times A \times B,$$

where I = ampere rating of fuse; W = D.C. output of rectifier in watts; A = rectifier efficiency expressed as a decimal; B = power factor of outfit; and E = A.C. voltage. The rectifier efficiency is usually between 0·40 and 0·50 and the power factor is 0·90 in most cases. Where high reactance is used to smooth out pulsations, however, the power factor will be about 0·57.

METHODS OF BALANCING MACHINES.

By A. B. EASON, M.A., A.M.I.E.E.

THIS article deals with various types of balancing machines on the market and with the principles upon which such machines work. There is no need to discuss the mathematical portion of the subject fully, as this is dealt with in articles mentioned later, and in those of Andrews (*Mechanical World*, Vol. 62, page 90, 1917), Heidebroek (*Zeit. Ver. Deut. Ingr.*, Vol. 60, page 11, 1916, and *Journal*, American Society of Mechanical Engineers, Vol. 38, page 268, 1916), Hymans (*Auto. Engineer*, Vol. 7, page 79, 1917). One need only explain the terms "static" and "dynamic" balance. Consider fig. 1, which represents symbolically the conditions of a body rotating round the axis X Y: (*a*) represents a homogeneous cylindrical shaft with two equal weights M, in the same axial plane at equal and opposite distances from the axis. This system is in static balance, and, if rotated, there is no unbalanced force or couple; the system is thus also in dynamic balance; (*b*) represents the same shaft with the equal weights displaced along the shaft; this system is still in static balance, as there is no unbalanced force tending to turn the body round its axis X Y. But when rotated with regular velocity ω, there will exist equal and opposite centrifugal forces $M r \omega^2$, causing an unbalance couple $M r \omega^2 l$, which will tend to turn the whole shaft in the axial plane through the bearings. The force on the bearing at X will vary above and below the static force due to the weight by $M r \omega^2 (l/L)$, according as the left-hand weight is below or above the axis of rotation; (*c*) represents the same shaft with unequal weights at opposite sides of the axis; this system is in both static and dynamic unbalance. When rotated, the external forces exerted on the bearings are a couple $M r \omega^2$ plus an unbalance force $= m r \omega^2$. The plane in which these forces act is continually rotating round the axis, as the body rotates.

When a body is in absolute static balance, there is no force tending to rotate the body round the axis X Y. In absolute dynamic balance there is no couple tending to turn the axis X Y either about X or Y. No rotating body is perfectly balanced; the amount of unbalance may be inappreciable, and in well-designed machines is always made innocuous. To reduce the unbalance to negligible proportions is the object of all balancing arrangements.

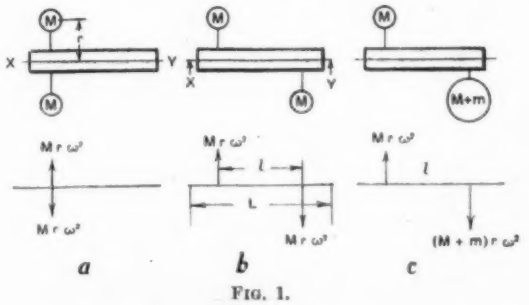


FIG. 1.

STATIC BALANCE.

Consider the method of getting static balance by placing the body on parallel ways; the journals of the body rest on two smooth horizontal surfaces, upon which they are

free to rotate in either direction. If the vertical plane in which the centre of gravity lies does not pass through the points or lines at which the journals touch the ways, there will be a couple tending to turn the body (see fig. 2). Whether the body turns or not depends upon the magnitude of the couple as compared with the frictional moment resisting motion. The limiting load allowable on parallel ways is about 750 d lb. per inch width, where d is the diameter of the journal in inches. If the ways are $1\frac{1}{2}$ in. wide and $d = 10$ in., then each side might bear a load of 11,250 lb. It is obvious that the line of contact between the journal and the ways cannot be a true line, but must have some width, say t. Suppose $t = 0{\cdot}005$ in., and that the centre of gravity of the body is directly above the mid-point of this width; let a weight be added to the body to unbalance it; until the centre of gravity of the body has been displaced by more than 0·0025 in., there will be no turning moment apparent, as the downward force due to the weight of the body will still act within the area of support (fig. 2).

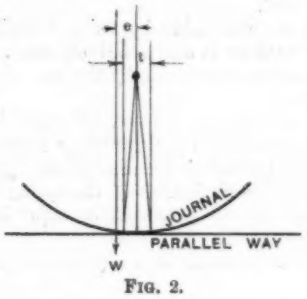


FIG. 2.

The turning moment $w\,e$ (e being ft.), which will just begin to rotate the body, we shall denote by 16 $w\,f$ in oz.-in., where w is in lb., and f is in inches. Akimoff (*American Mach.*, Vol. 47, page 1,121, 1917) states that Resal's formula for the residual unbalance not perceptible by parallel-way balancing, is—

Shaft. diam., inches.	Weight, lb.	Unbalance, oz.-in.	Kg.-cm.	Value of f, inches.
1	10,000	500	36	0·0031
2	10,000	700	50	0·0044
6	5,000	600	43	0·0075
12	5,000	800	58	0·0100

The unbalance being $w\,f$, f gives the possible eccentricity of the centre of gravity. Hertz says that the residual unbalance $= 465\ (10)^{-6}\ p\ (p\,d)^{1/2}$ oz.-in., where p is the pressure per inch width of the ways. Heidebroek says that when balancing on parallel ways the eccentricity of the centre of gravity which is not revealed is 0·02 in. (0·5 mm.); but if the journals are placed on four rollers, eccentricities as low as 0·003 in. (0·07 mm.) are recognisable. No mention is made of the weight of the body to which these figures refer; but rollers would naturally reveal a greater residual unbalance than parallel ways in any case. Hering (*Electrical World*, Vol. 72, page 389, 1918) speaking with Akimoff's approval, mentions that 0·4 oz.-in. (29 gm.-cm.) is a reasonable amount of static unbalance to allow in a 200-lb. (90 kg.), armature rotating at 1,000 R.P.M. No amounts for other sizes are stated.

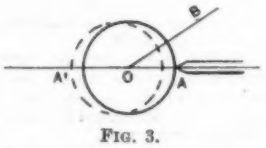


FIG. 3.

MODERN METHODS OF STATIC BALANCING.

The up-to-date method of balancing consists in supporting the body upon a spring suspension of some sort; the body can then oscillate to and fro when moved from the position of equilibrium. When set in rotation at such a speed that the period of action of the unbalance forces coincides with the natural period of oscillation of the suspended body, the amplitude of the vibrations will become perceptible, even though the amount or unbalance is very small. Having found the existence of unbalance, one has to find the axial plane in which the unbalance is situated, so as to either remove excess weight or to add additional weight. The old-fashioned method is to allow a pencil or chalk to touch the rotating body; suppose the body is an armature, and is on bearings free to slide horizontally under spring control; at each revolution a point (see fig. 3), A, say, will be the extreme point on the line of oscillation. The chalk mark would appear, therefore, on a particular commutator bar. The plane of unbalance is not the plane passing through O and A, but is displaced by an angle whose value depends upon how near resonance the revolutions of the armature may be. Heidebroek (*loc. cit.*) gives figures for this angular displacement in a particular case, viz.:—

Angular displacement ...	8	10	70	90	165	172
Revs. per min.	630	640	650	652	660	670

This shows that the relative position of the plane of maximum displacement and of the unbalance plane varies rapidly at the point of resonance. Below resonance the unbalance plane is slightly in advance of the plane of maximum displacement; at resonance it is 90° in advance; above resonance the advance increases to 180°. From the above figures it is seen that the position of the chalk mark (assuming it to be only a point) would lie in an arc between 70° and 165°, while the revolutions only varied from 650 to 660 R.P.M.; in order to get reasonable accuracy, one must rotate the body at resonant speed, and must then keep the speed constant at this point. The resonant point is chosen because the maximum displacement will occur then; as the chalk mark will cover more than a point, the body is rotated first one way and then the other, and then the point midway between the chalk lines is taken as being the unbalance plane. Having found the *plane* of unbalance, one finds by trial and error the most suitable weights to improve balance until it is within tolerable limits.

Akimoff (*American Mach.*, Vol. 47, page 1,121, 1917) finds the *amount* of static unbalance by Lavatzeck's method; the body to be balanced is suspended in a frame which can oscillate as a pendulum, and is then rotated at a speed to coincide with the natural period of oscillation of the frame and body.

DYNAMIC BALANCING.

When dynamic unbalance exists, the couple tends to make the axis vibrate angularly round a point O (fig. 4), in contrast to the tendency to make it move parallel with itself, viz., X X, Y Y, as with static unbalance. To balance this couple, one must add two equal weights M′ (or their equivalent) in one axial plane at opposite sides of the axis, and separated along the axis by L′, so that $M'\,L'\,r\,\omega^2 = M\,r\,\omega^2\,l$. Obviously balancing done at any one speed will be satisfactory at any other speed, except in so far as (*a*) imperceptible unbalance at, say, 400 R.P.M., may become perceptible at 3,000 R.P.M., as its magnitude will have increased by $(30/4)^2 = 56$ times; (*b*) the unbalance is due to electrical sources, which may vary with the speed. Hering (*loc. cit.*) states that a dynamic unbalance of 2,190 cm.-gm.-cm. (12 in.-oz.-in.) for a 90 kg. (200 lb.) armature, running at 1,000 R.P.M. is permissible.

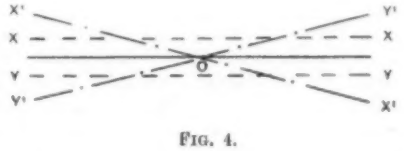


FIG. 4.

Unfortunately, no other speeds or weights are mentioned; but assuming the same percentage unbalance is allowable in other cases, then one might say—

Permissible unbalance $= 2{\cdot}44\ (10)^{-8}\ n^2$ W, cm.-gm.-cm.
$= 0{\cdot}54\ (10)^{-10}\ n^2$ W′, in.-oz.-in.

W being in kilograms; W′ in lb.; n = R.P.M.

In *Engineering*, Vol. 97, page 349, 1914, there is a description of a machine for balancing fly-wheels. The fly-wheel is first balanced statically when placed horizontally upon a needle point. It can then be rotated upon the

needle point, and will tilt if it is out of balance; a chalk pencil is allowed to touch the high spot on the upper surface; the presence and absence of chalk will show where the unbalance exists. Lumps of clay are then added until a balance is found; holes are then drilled opposite to where the clay lumps are.

This is obviously a relatively rough method of getting balance, as the weights and centres of gravity of the lumps of clay will not be accurately known. To get balance equal lumps must be added at opposite sides of the central plane. In the American *Electrical Review*, Vol. 72, page 571, 1918, will be found charts giving the weight of metal removed when holes of various sizes are drilled. Akimoff (*Transactions* American Society of Mechanical Engineers, Vol. 38, page 367, 1916) describes his machine with rods and disks for balancing bodies. In his remarks he depreciates the value of the chalk mark method of balancing by noting the position of "high spots"; he emphasises the necessity of balancing statically before proceeding to balance dynamically. This machine of Akimoff's, and also the Norton balancing machine, are described by Hymans in the *Auto. Engineer*, Vol. 7, page 79, 1917. The principle of Akimoff's machine is shown in fig. 5. The machine to be balanced is placed upon a beam, one end of which is hinged, and the other end of which rests upon a spring. Underneath the beam is fixed a driving motor M, and the balancing arrangement, consisting of two disks, with six sliding rods placed parallel to the axis. This system is in perfect balance. The body to be balanced is rotated at

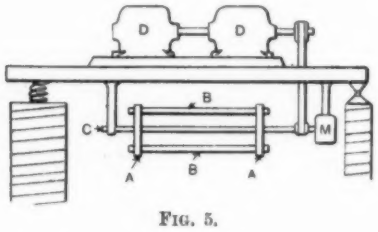


FIG. 5.

such a speed that any vibrations existing shall be in resonance with the oscillations of the beam and its load on the spring. The rods B can be moved parallel to the axis C while in motion, so that a couple can be exerted to equalise the unbalance couple of the body D; the amount of the couple exerted by B depends upon how far the rods are displaced in the disks A; the plane of the two rods shown is also adjustable about the axis C, so that the couple can be introduced in the plane parallel to the unbalance plane of body D. The rods are adjusted until the system, as a whole, ceases to vibrate. The amount of unbalance can then be read off upon a scale marked on the balancing system. Actually in the machine six rods are used, but only two are shown in fig. 5. Akimoff (*Amer. Mach.*, Vol. 47, page 1,121, 1917), mentions an improvement he has made in the above machine by replacing the disks and rods by two disks, each with a single pin projecting from its surface; there are corresponding holes in the other disk, so that when the disks are placed close together they are perfectly balanced. Unbalance is brought about by separating them.

Other references to methods of balancing may be mentioned here. Wheeler and Southwell (*Engineering*, Vol. 99, page 64, 1915) describe the balancing of large turbine rotors, using mirrors and a beam of light to reveal unbalance. Commander Cleary (*Journal* American Society of Naval Engineers, Vol. 30, page 1, 1918) describes the same method, used in America. Heidebroek (*Zeit. Ver. Deut. Ingr.*, Vol. 60, page 11, 1916) describes Lavaczzeck's method of balancing, where the rotating body is supported on bearings, one of which moves in the arc of a circle, whose centre is the other bearing, under the control of springs. In an example quoted, a 100-kg. rotor was run at resonant speed, and a weight of 0·5 gm. placed at a distance of 300 mm. from the centre of gravity of the body, produced an amplitude of vibration of 0·035 mm.; this means that a displacement of the centre of gravity by 0·001 mm. was revealed by the machine.

Törbet (*Journal* American Society of Naval Engineers, Vol. 30, page 518, 1918) discusses balancing of machines and the vibrations of the foundations from a mathematical point of view, and suggests how to determine the unbalance from the forces acting on the bearings. Brinton (*Electric Journal*, Vol. 15, page 349, 1918) describes the Carl Wenstrom balancing machine, which is based on Lavatzeck's idea. This article is reproduced in the *Electrician*, Vol. 82, page 128, January 24th, 1919. The machine is also described in *Aerial Age Weekly*, April 29th, 1918. *Machinery* (New York), in Vol. 25, page 285, December, 1918, and page 422, January, 1919, describes all the existing types of machines. Jeffcott (*Phil. Mag.*, Vol. 37, page 304, 1919) discusses the question of balance from a mathematical point of view. Heyman (*Electrotech. Zeit.*, Vol. 44, page 234, &c., May 22nd and 29th, 1919) describes the whole matter in a very well illustrated and complete article.

The conclusions to be drawn may be summed up thus:—

1. Very accurate balancing is possible if proper balancing machines are used.

2. The balance obtainable by using "chalk mark" and "high spot" methods is only relatively good.

3. Static balance obtainable by the use of parallel ways is relatively poor.

4. Definite information to cover all cases is required, as to the unbalance which is permissible or tolerable.

5. Where the natural period of oscillation of the supports is being utilised, the deflection of the spring for the superincumbent load should be about $3{,}520/n^2$ in., where n is the speed of the machine in R.P.M.

$$\text{Time of swing} = 2\pi\,(\text{deflection}/g).$$

WAGES IN THE LONDON DISTRICT.

THE Industrial Court has issued an award relating to electricity undertakings in London and the adjoining district (war-wage advance), dated December 19th, 1919.

The parties were on the one hand, the Electrical Trades Union, the National Amalgamated Society of Enginemen, Firemen, Mechanics, Motormen, and Electrical Workers, the National Union of General Workers, and the Workers' Union; and on the other, the London County Council, the local authorities of Leyton, Epsom, Ilford, Barking, Barnes, Beckenham, Erith, Walthamstow, Watford, Willesden, Battersea, Bermondsey, Fulham, Hackney, Hammersmith, Hampstead, Islington, Poplar, St. Pancras, St. Marylebone, Shoreditch, Southwark, Stepney, Stoke Newington, West Ham, Woolwich, Croydon, Ealing, East Ham, Kingston-on-Thames, and Wimbledon, the London electricity supply and tramway companies, the North Metropolitan Electric Power Supply and Distribution Companies, and the companies supplying Hendon, Twickenham and Teddington, Uxbridge and district, and Richmond (Surrey).

The terms of reference were a claim on behalf of the workpeople concerned in the employ of the undertakings for a further war-wage advance of 15s. per week.

1. The matter was referred under the Industrial Courts Act, 1919, by the Ministry of Labour to the Industrial Court for settlement, and representatives of the parties were heard on December 19th, 1919, in London. The Richmond (Surrey) Electric Light and Power Co., Ltd., was not represented.

2. The men concerned, aged 18 years and over, have received war advances not exceeding 28s. 6d. a week; in addition, those 21 years of age and over have received a bonus on earnings of 12½ per cent. in the case of timeworkers, and 7½ per cent. in the case of pieceworkers.

The decision of the Court was as follows:—

3. The men concerned, aged 18 years and over, shall receive an advance of 5s. a full ordinary week.

4. The amount hereby awarded is to be taken into account in the calculation of payment for overtime and night duty, and for work on Sundays and holidays, and will form part of the total earnings of time and pieceworkers upon which the bonuses of 12½ per cent. and 7½ per cent. respectively, are to be calculated; but it is not otherwise to apply to or affect present time rates, premium bonus rates, or piecework prices, and is not to be taken into account as part of the time rates for the purpose of fixing new piecework prices or bonus rates.

5. The Court's decision shall take effect from the pay-day immediately following December 1st, 1919, in respect of the pay period for which payment was made on that pay-day.

WILLIAM W. MACKENZIE
J. MCKIE BRYCE,
D. C. CUMMINGS.

A similar award relates to electrical workers on railways, and bears the same date. The parties were, on the one hand, the Trade Unions above-named, and on the other, the Railway Executive Committee, representing the railways operating in the London district. The terms of reference were a claim for an advance of 15s. per week.

The matter was referred under the Wages (Temporary Regulation) Acts, 1918 and 1919, by the Ministry of Labour to the Interim Court of Arbitration for settlement, and not having been settled by that Court before the passing of the Industrial Courts Act, transferred to the Industrial Court, and this award has effect as if it were an award of the Interim Court of Arbitration made under the Wages (Temporary Regulation) Act, 1918. Representatives of the parties were heard by the Industrial Court in London on December 19th, 1919.

The decision of the Court was, in effect, identical with the foregoing, with the following additions :—

This decision shall not apply to men who in respect to wages are at present on the same footing as men of a class other than electrical workers employed on railways.

The rates fixed in accordance with this decision shall be the substituted rates of the workpeople concerned for the purposes of the Wages (Temporary Regulation) Acts, 1918 and 1919, as modified by the Industrial Courts Act, 1919.

THE COAL REBATE.

UNDER Clause 5 of the Coal (Pit's Mouth) Prices Order and Direction, 1919, dated November 29th, 1919, the following prescription has been issued by the Controller of Coal Mines to Electricity Undertakings :—

Whereas under the provisions of Clause 5 of the above-mentioned order and direction it is provided (amongst other things) that where coal is delivered to an electricity undertaking the owners or secretary or manager may when paying therefor give a certificate either to the colliery owner or to the factor dealer or merchant from whom they bought that a proportion of the said coal has been or will be used by them for making electricity for domestic or household purposes, and shall in that case be entitled to deduct 10s. per ton from the price in respect of such proportion and that the Controller may prescribe the amount of coal in respect of which such deduction may be made as he in his absolute discretion thinks fit.

Now therefore the Controller hereby prescribes as follows :—

(*a*) In the case of coal delivered during the month of December, 1919, the amount of coal in respect of which the said deduction of 10s. per ton may be made shall be ascertained by reference to the proportion that the quantity of electricity supplied for domestic or household purposes during the third quarter of 1919 bears to the total quantity of electricity supplied during the same period and shall be determined and certified accordingly.

(*b*) In the case of coal delivered between January 1st, 1920, and March 31st, 1920, the amount of coal in respect of which the said deduction of 10s. per ton may be made shall be ascertained by reference to the proportion that the quantity of electricity supplied for domestic or household purposes during the fourth quarter of 1919 bears to the total quantity of electricity supplied during the same period and shall be determined and certified accordingly.

(*c*) In any subsequent quarter the amount of coal in respect of which the said deduction of 10s. per ton may be made shall be ascertained by reference to the proportion that the quantity of electricity supplied for domestic or household purposes during the corresponding quarter of the previous year bears to the total quantity of electricity supplied during the same period and shall be determined and certified accordingly.

Provided always that in respect of sums so deducted an allowance shall be made to each domestic or household consumer at the end of each quarter which shall be at that rate per unit which results from dividing the total weight of coal (in tons) used in the previous quarter by the total units supplied in such previous quarter, multiplying the quotient by 120 (the result being in pence) less such percentage in respect of expenses as may from time to time be approved by the Controller of Coal Mines.

The first allowance shall be given to the consumers at the end of the first quarter of 1920, and shall take account of deductions then actually made from the price of coal delivered between December 1st, 1919, and March 31st, 1920. Any surplus or deficiency shall be carried forward to the next quarter.

(Signed) A. R. DUNCAN,
Controller of Coal Mines.

Dated December 30th, 1919.

An Explanatory Memorandum on the Prescription (approved by the Controller of Coal Mines) has been prepared by a Committee consisting of :—

Mr. Roger T. Smith, President I.E.E. (Chairman), and representatives of

The Incorporated Municipal Electrical Association,

The Incorporated Association of Electric Power Companies,

The Conference of Chief Officials of London Electric Supply Companies,

The Provincial Electric Supply Committee of the United Kingdom, and

The Associated Municipal Electrical Engineers of Greater London.

The memorandum states that to obtain the rebate of 10s. per ton on the coal used for electricity supply for domestic or household purposes for December, 1919—

$$\text{Let } R_1 = \frac{\text{Electricity sold for domestic or household purposes during third quarter, 1919.}}{\text{Electricity sold for all purposes during third quarter, 1919.}}$$

The rebate at 10s. per ton on coal delivered during December will be—

$$\text{Rebate in £ sterling} = R_1 \times \text{total coal delivered during December} \times 10/20.$$

For January, February, and March, 1920, the fourth quarter of 1919 is taken, and a similar formula is given for the rebate on the total coal delivered during each month. For subsequent quarters the corresponding quarter of 1919 is taken.

Certificates are to be issued only at the end of each month after coal is delivered, and not when it is ordered. The total quantity of coal certified is to be divided between the different suppliers in proportion to the quantities delivered by each. Coal burnt from stock receives no rebate.

To pass on the rebate on the coal obtained (less 5 per cent. for expenses) to the consumer for domestic or household purposes, for the March quarter, 1920—

$$\text{Let } T_1 = \frac{\text{Tons of coal used in fourth quarter, 1919.}}{\text{Total units of electricity sold in fourth quarter, 1919.}}$$

The rate of the rebate to be passed on to the consumer for domestic or household supplies is 120 pence per ton, less 5 per cent., or 114 pence per ton.

For the three months January, February, and March, 1920, each unit of electricity sold for domestic or household purposes will receive a rebate in pence = $T_1 \times 114$ pence. The rebate itself is to be given as a lump sum, to be deducted from the account.

For any subsequent quarter in 1920 a similar rule holds good.

The rebate actually passed on is to be compared with the actual electricity sold and the actual coal used for domestic or household purposes, the coal used being calculated as provided for in the order as if every unit (whether for industrial or domestic supply) required the same amount of coal.

Any deficiency or surplus in the rebate passed on is to be carried on to the next quarter, it being the intention of the order that only the rebate actually received for the coal, less 5 per cent. for expenses, should in the aggregate be passed on.

LEGAL.

WORKMEN'S COMPENSATION CASES.

IN the Bow County Court, on Monday, before Judge Graham, K.C., in a case under the Workmen's Compensation Act, Edward Hanxwell, of Stratford, was the applicant, and the Charing Cross, West End and City Electric Supply Co., were the respondents. Mr. Shakespeare appeared for the applicant, and Mr. Rowlands for the respondents. It appeared that the applicant was employed as an assistant engine driver at the power station at Marsh Lane, and on December 1st, 1918, a ladder fell, causing him to fall into the pit, and his right wrist was broken. At that time he was earning £4 13s. 2d. a week. He went back at the end of March, and was found light work at £3 6s. 8d. a week, and his compensation was lowered from 25s. to 10s. a week, for eight weeks. Then he was put back on his old work for a time, but found himself incapable of doing it. The respondents discharged him, but the Trade Unionists took the matter up, with the result that three days later applicant was taken back as an assistant box cleaner at £3 10s. a week. He claimed that since July he had been at a loss of the difference between the £3 10s. a week and the £4 13s. 2d. he had originally earned. On the other hand, the respondents contended that the high wage earned by the man was only caused by his temporarily doing some very long overtime, but it was of such short duration that it would not be fair to include it in an average for compensation. Again they suggested that the man had recovered sufficiently to do his old work, and that the reason for his discharge was because he absented himself for days without letting them know why, and it would be impossible to carry on a great power plant if that was to go on. They agreed to take him back on the representations of his Union, but they could not then give him his old job, as a number of their old employés, who had been in the Army, had been demobilised, and they had to carry out their promise to find them jobs. The applicant had only been taken on during the war, and was not entitled to the same consideration as the demobilised men.

Judge Graham reserved judgment.

SHERIFF-SUBSTITUTE GUY gave his decision at Edinburgh on Saturday in a case in which a Portobello woman sought compensation for herself and two children from the Niddrie and Benhar Coal Co. Pursuer sued for £300 in respect of the death of her husband while working an electrically-driven coal-cutting machine in the Woolmet Pit, Niddrie. The Sheriff held that the cause of death was electrocution. It had been agreed between the parties that in the event of the pursuer succeeding in the action, the compensation should be fixed at £300, and he granted a decree accordingly, finding the defenders also liable in expenses.

HODGES *v.* WEBB.

ON Monday last, in the Chancery Division, Mr. Justice Peterson commenced the hearing of this case, in which plaintiff, a foreman electrician, a former member of the E.T.U., from which he resigned (he joined the National Association of Supervising Electricians), asked that the defendant, Secretary of the E.T.U., should be restrained from wrongfully interfering with, or attempting to interfere with, his employment and his right to dispose of his labour as he willed. Hodges complained that Webb coerced his employers (Messrs. Tyler & Freeman), while doing work at Watford for the Watford Manufacturing Co., into dismissing him, by calling out on strike the 12 men who were working under him. Correspondence was read which showed that Messrs. Tyler & Freeman received a letter from Mr. Wyatt, Assistant London District Secretary, in which he said that the men were not called off, but that the whole of the men, members and non-members of the E.T.U., came out together owing to the fact that the foreman was a member of the N.A.S.E., and also because of the arrogant attitude adopted by Mr. Hodges toward Mr. Webb when the latter approached him. In the course of the hearing plaintiff said that in October last Mr. Webb had told him that unless he joined the E.T.U. he would lose his livelihood. This he refused to do. At the end of November last plaintiff had to go, and he had been out of employment until the hearing of the motion in this action. Messrs. Tyler and Freeman took him into their employ again in December. Mr. Tyler gave evidence on Monday. He referred to the relations of his firm with the E.T.U., and said that the firm dismissed plaintiff because the Watford Manufacturing Co. ordered them to push on with the work. They were sorry to lose him, but they had no option but to dismiss him. Under cross-examination, he said that the E.T.U. had been in antagonism with the N.A.S.E. regarding whether E.T.U. members should work with N.A.S.E. members. The latter Association had been refused federation by the Trade Union Congress owing to the blackball of the London District. Mr. Tyler denied that the N.A.S.E. was formed at the instigation of the National Federated Electrical Association.

The hearing was resumed on Tuesday when Mr. Tyler was further cross-examined. Evidence was also given by Mr. Banister, hon. secretary of the N.A.S.E., and others. The defendant's case was then opened and he was giving evidence when the Court again adjourned.

(To be continued.)

DIRECT UNITED STATES CABLE CO., LTD. *v.* WESTERN UNION TELEGRAPH CO.

THIS case was mentioned on an adjourned summons in the Chancery Division, before Mr. Justice Peterson, on Monday.

MR. MAUGHAM, K.C., said that the position at the moment was that the witnesses from America had not yet arrived. They were expected to arrive on or about January 26th, and he asked his Lordship to fix a date for the hearing of the action shortly after that date. He suggested Monday, February 2nd.

MR. WHINNEY, appearing on the other side, said he would like to see the documents before the case came on again.

MR. MAUGHAM said that copies of all the documents were here now, and Mr. Whinney could see them.

His LORDSHIP fixed February 2nd provisionally for the hearing of the case.

A STERLING WORKS VISIT.

THE Sterling Telephone & Electric Co.'s business was established in 1900, and was registered as a limited liability company in 1909. The company manufactures telephones, wireless telegraph instruments, mine signalling apparatus, including shaft signalling systems, mine exploders (blasting machines), electric bells and indicators of every variety. The head office of the company is situated in London, and comprises a handsome suite of offices, also a selling organisation, stores, showrooms, and other departments. Here may be seen samples of the company's various manufactures, the outstanding feature of which is the large variety of articles which form part of the telephone and signalling industry, due to the fact that the instruments are required to work under such varied conditions.

Early in 1909 the company secured valuable freehold works situated on the eastern outskirts of London at Dagenham, in Essex. The ground area is approximately 35 acres; the buildings and plant cover an area of six acres; sports ground five

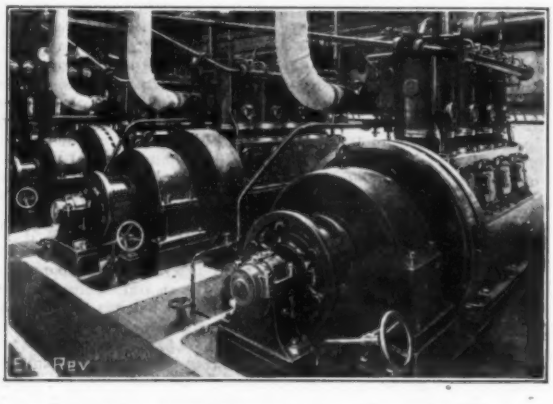


FIG. 1.—GENERATING STATION AT THE STERLING WORKS.

FIG. 2.—TELEPHONE MACHINE SHOP.

acres; for the benefit of the workpeople 18 acres have been reserved for a housing society, and the balance is available for future extensions. Building operations in the housing scheme are, we understand, to be commenced in the near future.

The works, primarily intended for the manufacture of all kinds of telephones and kindred apparatus, are capable of producing on mass production lines all kinds of small engineering parts. They are up to date, the equipment comprising high-class modern machinery, all of which is guarded to prevent accidents to the operators. A feature is the use of special jigs and tools which economise time and labour and ensure a high degree of accuracy in the work. The employés work in hygienic conditions, the various shops being well lighted and ventilated, as well as being more spacious than is usually the case.

Important work was carried out for the Ministry of Munitions during the war period, when the total number of employés exceeded 2,500. The number of pieces manufactured for munitions contracts would approximate 135 millions, representing a large variety of parts each requiring many operations and all manufactured to very fine limits. During the early stages of the war great progress was made with the company's wireless telegraph instrument works, which are situated in London. These works were considered of such importance that in the middle of 1915 they were, with the entire staff, taken over by the War Department and carried on by it.

Much attention has been given to the welfare, athletic, and social side of the organisation. The works' canteen is excellently equipped; hot and cold meals are prepared on the premises, the kitchen plant being sufficient to enable several thousand workers to be catered for. A commodious recreation room has been erected adjoining the canteen, and has proved a boon to the employés and the members of the Athletic and Social Club. Concerts and dances are held during meal hours and in the evenings, the talent for which is drawn exclusively from the workers. The company has also provided a very fine recreation ground, where cricket, tennis, football and bowls are enjoyed, and some excellent records have been set up. A double rifle range is attached to the works, which is largely patronised, and there is also a very successful cycling club connected with the sports section. A well-equipped first-aid hospital is situated in the heart of the works, where numerous cases of minor accidents and some more serious have received attention at the hands of qualified nurses.

The works are heated by means of a system of hot-water pipes, and they are electrically driven, and electric lighting is installed throughout. The company has its own generating station, an interior view of which is shown in fig. 1, the plant comprising 5 high-speed, four-cylinder, vertical gas engines, direct coupled to 100-KW. generators, the capacity of which is 650 H.P. and the output 450 KW. The gas is supplied by five producers using anthracite coal. The machine tools are belt-driven by means of lines of shafting, which in turn

are motor-driven by enclosed silent chains, the motors all being placed overhead. In the main machine shop the automatic turret section can produce over 600,000 small engineering parts weekly; the machines in the capstan lathe section are operated largely by women, who handle them with great dexterity. Most of the parts produced in the machine shops

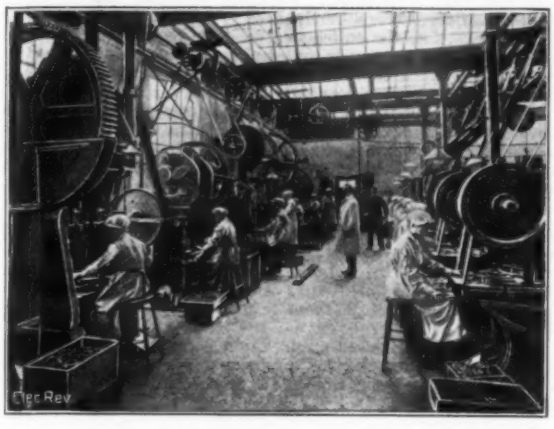


FIG. 3.—PART OF POWER PRESS SHOP.

pass through the high-speed sensitive drill section, where women are almost exclusively employed. The telephone machine shop is more particularly engaged in the production of telephone parts as distinct from other products. Fig. 2 is a view of this shop, in which a large assortment of high-class machine tools is employed. The view also indicates the nature of the lighting system and the commodiousness of the shops. In other instances individual machines are lighted locally. Fig. 3 shows a section of the power press shop, in which the success of the operations depends largely upon the efficiency of special press tools which are designed and produced in the works' toolroom, which may be regarded as the mainstay of the works.

Brass and steel turnings (swarf) are removed from the various machine shops and treated by hydro-extractors and oil filtration plant. The oil is extracted by centrifugal force and filtered by a special process. In the annealing shop all the tools as well as the magnets required in the manufacture of telephones are hardened. In the grinding and polishing shop small components are prepared for electro-plating. The air is kept free from dust by a hurricane extractor fitted at each operator's position. Hoods are fitted above the vats in the electro-plating shop, where components are zinced, tinned, coppered, or nickel-plated, by means of which the fumes are drawn out of the building by a powerful fan. In the enamel shop care is exercised to keep the air dust free while articles are being dipped or sprayed, and precautions are taken against fire in the gas-heated baking ovens which adjoin.

In the coil-winding department coils are wound to specific resistance, and must pass a severe test; the delicate work, demanding patience and skill, is handled exclusively by girls. The whole of the printing required in connection with the works is done on the premises; this department was greatly appreciated during the war, when constantly changing conditions had to be met without delay. In the general office buildings, drawing offices for tool and instrument design, a planning department, and a laboratory are included.

In concluding this survey of the Sterling Telephone Co.'s works we have to thank Mr. Guy Burney, managing director, and Mr. A. Anderson, works manager, for the courteous and hospitable manner in which we were received and conducted over the works at the time of our visit, and also for supplying photographs from which the above illustrations were reproduced.

BUSINESS NOTES.

Municipal Finance.—We read in the financial notes in the *Times* that several municipalities are favouring the idea of the establishment of a municipal bank. The Manchester City Council has agreed to appoint a special committee "to consider the desirability of establishing and carrying on a national bank, with municipal branches in all large centres of industry and commerce, to enable, amongst other things, municipal corporations and other bodies to utilise their surplus assets to finance house building and other public undertakings, thereby saving interest on borrowed moneys, the repayment of which under the present system entails a total expenditure equal to twice or thereabouts of the original capital expenditure."

Exhibitions at Sao Paulo.—The British Chamber of Commerce at Sao Paulo and Southern Brazil is organising a series of exhibitions of British products. The first, devoted to hardware of every description, is being held from January 1st to March 1st, 1920. The second from April 1st to June 30th, will deal with fancy goods, including electrical batteries, pocket lamps and fancy articles. From October 1st to December 31st the exhibition will be devoted to glass, china and earthenware, including electric bulbs, laboratory and lighting glass, insulating materials and laboratory porcelain. From January 1st to March 30th, 1922 (two years hence be it noted), electrical goods will have the floor to themselves, and electrical manufactures of very many kinds coming in an alphabetical list from A (accumulators), to T (trolley wheels) will be displayed. Some further particulars may be found in the *Board of Trade Journal*.

Swedish Company's Reconstruction.—According to Reuter, the Volta Electric Co., Ltd., Stockholm, is to be liquidated, and a resolution for reconstruction had been provisionally accepted. The business will be taken over by a new company with a capital of Kr. 6,500,000, of which Kr. 3,500,000 will be issued in founders' shares, and Kr. 3,000,000 in preference shares. Of the founders' shares, Kr. 2,500,000, or 50 per cent. of the present capital, would go to present shareholders.

Italy.—ELECTRICAL UNDERTAKINGS.—Numerous companies are being formed in Italy for the purpose of the generation and distribution of electrical power. Many of these, such as the Società Anonima Forze Idroelettrica Meridionali and the Società Ligure-Toscana di Elettricità, have as their object the harnessing of Italy's water power. The majority of the remainder are relying on lignite and other low-grade fuels, which abound in the valley of the Arno, for the production of energy.

Empty Cases.—Owing to the increased railway rates and other transport considerations, the GENERAL ELECTRIC CO., LTD., will in future only make a nominal charge for packing cases, so that clients may retain them or dispose of them locally, instead of returning them. Cases returned "carriage paid," in good condition, will be credited in full as before.

Armstrong-Whitworth Diesel Engines.—Realising the great future of the Diesel engine for ship propulsion, MESSRS. ARMSTRONG-WHITWORTH & CO. have entered into an agreement with the well-known Swiss firm of Sulzer Bros., whereby they acquire a licence to manufacture and sell, in Great Britain and the Colonies, two-cycle marine engines embodying the best features of the Sulzer system. It has been decided to adopt the two-cycle principle on account of the proved reliability and efficiency of this type of engine, its high ratio of horse-power to size and weight, and its ability to work continuously on Californian or Mexican crude oils of high sulphur and asphalt content, which are the cheapest fuels at present on the market. Engines aggregating over 600,000 B H P. have now been built by Sulzer Bros. on the two-cycle principle, and the experience they have gained in regard to both design and manufacture will be placed at the disposal of Armstrongs in the production of the new engine.—*Financial Times.*

Foreign Trade.—DECEMBER FIGURES.—The following are the values given of electrical goods and machinery in the official returns of imports and exports for December :—

	December, 1919.	*Inc. or dec.*	12 *months*, 1919. *Inc. or dec.*
IMPORTS.	£	£	£
Electrical goods, &c. ...	141,822	+ 82,700	+ 156,693
Machinery	1,714,943	+ 922,051	+ 4,362,299
EXPORTS.			
Electrical goods, &c. ...	646,155	+ 401,776	+ 3,424,612
Machinery	3,884,429	+2,710,109	+16,618,006

Preference to Australian Manufactures.—The South Australian Chamber of Manufactures has decided to use efforts to get both branches of the State Parliament to pass a resolution similar to that carried some years ago by the Victorian legislature as follows :—"That in obtaining machinery, goods or material for the service of the State, the Government shall, with a view to the encouragement of our own manufacturers and producers, give substantial and effective preference to those manufactured or produced in the Commonwealth ; and further, that the prices and tenders for all machinery, goods or material so obtained, which are manufactured or produced outside the Commonwealth, shall be laid on the table of the House at the end of each financial year, or as soon thereafter as Parliament meets." The meeting also discussed the disadvantages under which contractors tendering for Government work are placed through awards of higher wages being made after their contracts have been accepted. It was resolved :—"That in view of the uncertainty of the labour position, and the fact that wages are fixed by a Government tribunal, the Chamber approach the Government with the object of having included in the conditions of Government contract a rise and fall clause in regard to wages."—*Tenders.*

Germany and her Foreign Markets.—It is generally assumed in the German Press that, apart from the danger of an "economic war" on Germany, there is also what is termed a "psychological epidemic" with which entire nations are afflicted. This is resolving itself into an aversion for everything German, which will continue for some time to lead to a situation in all economic life similar to a state of war. To overcome this prejudice many suggestions have been made, some of which have been carried out. The first was the idea of selling German merchandise under the trade-marks of neutral countries. This, it is stated, has necessarily been abandoned. Another project is the establishment of branch factories in neutral countries. But here again, Switzerland, for example, has taken measures to prevent articles produced by such branch plants from bearing marks indicating Swiss manufacture. Such articles are not admitted to the Sample Fair at Basle, and it is anticipated that there will be future legislation, at least in France and England, to prevent entrance of these pseudo-Swiss products. It is hoped, however, that it may be possible to overcome these difficulties by founding in neutral countries local (national) firms under the control of dummy directors. For the period immediately following the war, at least, it is urged that everything points to the neutral as the proper representative of German firms. He can enter France and England without difficulty, and can sell his customers German goods, which naturally speak for themselves.—*Board of Trade Journal.*

Forthcoming Congress of Manufacturers.—*The Times* reports that the Federation of British Industries is organising a congress, to which the various manufacturers and trade organisations of the country will be invited to send representatives, in London early in February.

The Situation in France.—It has been the practice at the annual meetings of the Compagnie Générale d'Electricité, in Paris, for M. Azaria, deputy manager, to submit a forecast of the possible course of business, not only in the new financial year, but also for subsequent years. At the recent general meeting, however, the customary resolutions were adopted without any statement being made by the deputy manager, and it seemed at first as if the shareholders would disperse without any information being given on the question. Nevertheless, the earnest request of the shareholders induced M. Azaria, who appeared to be desirous of discontinuing the tradition, to rise to the occasion, although he remarked that any prevision at the present time is absolutely impossible owing to the very difficult conditions of working which prevail. The deputy manager stated that it happened frequently, too frequently for their liking, that their works were brought to a standstill—stopped when they were in the environs of Paris, as those at Ivry and Vitry, owing to the lack of current through the works which supplied them having no coal; and stopped when the question concerned works which were supplied by the Compagnie Générale as a consequence of the failure in the delivery of raw materials to the latter, particularly coal. Under the circumstances, what forecast could be made? If, however, the coal and transport crisis were to come to an end—which was a question of time—or if the situation in this respect were to be mitigated, even slightly, the requirements of consumers in the manufactures produced by the company, as well as in all those made by industry in general, were such that industrial prosperity could not fail to become very considerable; and the company would derive advantage therefrom as well as others, neither more nor less. Coming to consider the problem of supply works and distributing companies, the deputy manager remarked that the companies were gripped as in a vice by the specifications or conditions of concession, which hindered them from increasing their sale prices for the supply of energy, but which did not prevent them from experiencing the immense repercussions caused by the growth in the prices of the raw materials they used, especially coal. Thus the price of coal, which was quite normal before the war, at 18, 20 or 25 francs per ton—and when it advanced to 30 or 35 francs, the rate was considered to be fantastic—had risen to 200, 300 and 500 francs per ton. As the sale prices under the terms of the concessions could not be increased without official sanction, the question arose as to how to obtain compensation for the excess of expenses over receipts, which amounted to millions of francs. The attention of the public authorities had frequently been drawn to the situation of affairs, but many other matters had to be considered on account of the war. The war, however, was over; the public authorities and the municipalities now understood that the companies could not continue to sell at the pre-war price a product which at present cost them two, three and four times more; and the speaker foreshadowed the impending issue by the Ministres des Travaux Publics et de l'Interieur of an instruction to the municipal and other competent authorities, authorising an increase in the charges for supply. Under these circumstances, the deputy manager expressed the opinion that the supply business would first gradually recover financial equilibrium, and subsequently the prosperity which it enjoyed prior to the war.

South American Trade.—Speaking at a luncheon of the British and Latin-American Chamber of Commerce, Sir James Kemnal, the president, said that a great amount of work was being done by the chamber in bringing firms in South America into close contact with British manufacturers. During the past year 1,250 inquiries were received by the chamber from South America, and 3,000 inquiries were received regarding South America and trade openings. During the same period the agencies of 200 British firms were placed in the hands of reliable South American representatives, and those agencies were working successfully.

Shanghai Electrical Undertaking.—The Special Correspondent at Shanghai of the *Times Trade Supplement* says that some very good contracts for engineering material have been secured recently by British firms. Engineering firms generally are very optimistic as to the future in China. In his presidental address at the meeting of the Engineering Society, the President, as an instance of the growth of industrial enterprises, cited the Municipal Electricity Department. With the additions now in course of erection, the power station would be able to handle a load of 77,000 KW. Yet, the anticipated demand for power from mills now in course of erection or contemplated in the neighbourhood of Shanghai was such that the engineer-in-chief expects to have to go home in the coming year to place orders for additional plant. "It would pay some of the big electrical companies, which have been formed since the signing of the Armistice, to send out experts to study the electrical question on the spot, and establish their own offices here. There would be ample scope for their activities in China."

The Engineering Strike in Sweden.—A Reuter dispatch dated January 9th, stated that the situation in the dispute with the Swedish engineering industry was becoming more critical. A lock-out was probably to be declared by all the factories belonging to the Swedish Mechanical Works Association (Sveriges Verkstadsfoerening) in support of those firms where a strike had been declared.

The Times correspondent at Stockholm says that the cause of the strike, besides a demand for increased wages in some cases, is a dispute as to the regulation of the hours of labour to meet the provisions of the new law for an eight-hour day, which was voted last summer and which entered into force at the beginning of this year. The employers claim the right to apportion the eight hours during the day so as to suit the character of the work, while the workmen contend that they may complete their eight hours when and as they like.

Sydney Tendering Conditions.—The Sydney (N.S.W.) Municipal Council has decided that with regard to specifications and general conditions of tenders for the electric lighting department, in respect of which a conference has been held between representatives of the Council and representatives of the B.E.A.M.A., in Sydney, amendment of the Council's specification and general conditions, so far as the electric lighting department is concerned, be approved and adopted, to provide for the following :—

1. "Specifications" in future to be in such a form that while each tenderer must submit one formal tender precisely in accordance with the "specification" and general conditions, each tenderer shall be at liberty also, if he so wishes, to submit at least one alternative tender, this alternative tender to be for plant or apparatus, if the tenderer so wishes, differing from the "specification."

2. In "specifications" issued during the next 12 months, the penalty for late completion of contracts to be not more than ½ of 1 per cent. of the value of the contract per week, with a maximum of 5 per cent. of the value of the contract.

3. "Specifications" issued in future to set out standard rates on which the amounts of tenders are based for :—
(a) Freight rate per ton from Great Britain to Sydney.
(b) Freight rate per ton from United States of America to Sydney.
(c) Rate of exchange between Sydney and London.
(d) Rate of exchange between Australia and the United States of America.
(e) Price per ton for electrolytic copper on London market.
(f) Price per ton for lead on London market.
(g) Price per ton for tin on London market.

4. "Specifications" issued in future to provide for Council paying any extra amount which the contractor has to pay for labour in Australia as the result of an Award of a Wages Board or a Judgment of an Arbitration Court taking effect between the date of the sending in of the tender and the date of the completion of the contract.

Also that payments under future contracts be made in Australia as laid down under resolution of Council and agreed to by conference. By consent, the following clause was added :—

(h) Price per ton for tin, copper and lead on Sydney market for Australian manufactured goods.

Trade Union Methods.—In a letter to *The Times*, Mr. P. M. Brooke-Hitching states that in a large building, which is now nearing completion, flats are let to people who wish to obtain possession as early as possible. The builder is doing all that he can to expedite the work. A number of electricians are employed carrying out wiring for electric light. In order to meet the demand for telephones, the Post Office arranged to bring in the necessary cables. After this work had been going on for several days, an organiser of the Electrical Trades Union came to the buildings and informed the electricians working there that he would not allow the Post Office officials to continue their work, and that, if the Goverment men did not leave, he would call out every electrician immediately. As the completion of the electric light wiring was a more urgent matter than the installation of telephones, the builder had no option but to obey the dictates of the Electrical Trades Union organiser. This interference has apparently been accepted without demur by the Post Office.

What occasioned the action of the Union is not clear to us; is this the beginning of an attempt to force the Post Office electricians into the E.T.U.?

Patent Restoration.—An order has been made restoring Patent No. 23,082, of 1912, granted to ROBT. F. VENNER, for "Improvements in electric heating and cooking apparatus."

Auction Sale.—By direction of the Disposal Board, Ministry of Munitions, Messrs. Harris & Gillow will sell by auction, at Shoreham Camp, Sussex, on January 21st, 22nd, and 23rd, a quantity of building material, huts, camp equipment, and electrical appliances, comprising batten-holders, switches, wall-plugs, pendants, &c. For full particulars, see our advertisement pages to-day.

A French Undertaking.—The directors of Les Exploitations Electriques, S.A., of Paris, reporting on the year 1918-19, state that the difficulties experienced by the tramway and lighting undertakings managed by the company continued great. If labour had become less scarce through the progressive demobilisation which had rendered possible the return of a portion of the workmen, the prices of all raw materials, and coal in particular, had remained on a high level. On the other hand, wages had largely increased both in the case of the company and in that of its subsidiary companies. These conditions involved a heavy charge upon the subsidiary companies, and the directors had, therefore, applied to the concessioning authorities for permission to raise fares and charges for supply to a further extent than that previously granted. In most instances the municipalities and the departments had acceded to the request, but only after long and tedious negotiations. The company had taken an important part in the formation of Les Constructions Electriques du Rhône (Procédés Dick-Kerr), which was constituted in November, 1918. The object of the latter was the construction and maintenance of tramway rolling stock, motors and accessory tramway equipment, and works for this purpose were being built in the suburbs of Lyons. The participation of the Exploitations Electriques in the new undertaking would assure the former a supply of plant necessary for its subsidiaries. As net profits and balance forward the accounts of the parent company show the amount of 1,140,000 fr., permitting of the payment of a dividend of 16·25 fr. per ordinary share on a capital of 12,500,000 fr.

The A.E.G. and Austrian Water Powers.—With reference to the statement that the Berlin A.E.G. had been endeavouring to secure possession of the water powers in the Vorarlberg by means of direct purchase, it is reported that after preliminary negotiations the Government declined, on principle, to dispose of the water powers to another country, but expressed its readiness to enter into further negotiations on a different basis—namely, by the formation of a joint company in Vorarlberg, the State of which would possess 51 per cent. of the share capital, leaving 49 per cent. to be taken up by the A.E.G.

Book Notices.—"Lockwood's Builder's and Contractor's Price Book" for 1920. London: Crosby Lockwood & Son. 4s. net.—This is quite an old friend, and, in view of coming building activity, it will be much in demand, though, while giving prices "down to date," the editor recognises that owing to the fluctuating conditions to compile a definite set of prices for building work during 1920 is an impossibility. Sections relating to electric lighting and electric bells, prepared by Mr. A. P. Haslam, have been revised and enlarged. Prices of electric lighting, heating and domestic appliances, conduits, dynamos, motors, batteries, bells, and telephones are quoted from various manufacturers' lists. There are wages tables, legal notes, &c., and in the supplement the London Building Act of 1894 and other Acts, by-laws, and regulations affecting building operations occupy a great deal of space.

The *Chamber of Commerce Journal*, which is the official organ of the London Chamber of Commerce, is now published weekly (6d.), instead of monthly. Always a very useful paper for business men—employers and employed alike—it should be more so, owing to the prompter publication of many matters which is possible under the new arrangement.

"Science Abstracts" (A and B). Part 12. No. 264. Vol. XXII. December 30th, 1919. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

"Electrical Engineer's Diary for 1920." London: S. Davis and Co. Price 7s. 6d.

"The Dyeing Industry." By S. H. Higgins. Pp. viii + 189. London: Longmans, Green & Co. Price 8s. 6d. net.

Scientific Paper No. 349 of the Bureau of Standards, "Photo-electric Spectrophotometry by the Mill Method." Price 5 cents. Scientific Paper No. 334, "New Forms of Instruments for Showing the Presence and Amount of Combustible Gas in the Air." Price 15 cents. Washington: Government Printing Office.

Lead.—In their report, dated January 10th, MESSRS. G. CAWSON & CO. state:—

> The closing figures yesterday, £47 15s. prompt and January, and £48 5s. to £48 10s. March and April, are record prices, and they are not justified by the position of the metal. . . .
>
> There is a large supply of lead in the country, and it is a real hardship on consumers that they should be compelled to pay such tremendous prices, owing to speculation. Lead is coming forward quite freely, as shown by the arrivals last month of 12,496 tons. This month they promise to be quite as heavy. . . .
>
> The outlook is more confused than ever; should speculators continue their operations, the price may be driven still higher, although the eventual crash is bound to come sooner or later; it may even come sooner than anticipated.

Italian Engineering Combine for Near Eastern Trade.—The Agenzia Economica says that the following companies: "Breda," "Terni," "Officine Meccaniche gia' Mianie Silvestri," "Meccanica Lombarda," and "Moto-Aratruce," have come to an agreement, under the auspices of the Credito Italiano, to form the "Societa Italo-Orientale," which has as its object to concentrate into a single channel the exporting activities of the above industries in the Balkans and the Near East. The new company is beginning with a capital of 2,500,000 Italian lire, and has its head offices in Milan. In order to put into practice a plan for the co-operation of the countries with which the new company intends to trade; financial groups in these countries will be asked to contribute to the capital of the new company, places being reserved for their representatives on the board of directors.—*Reuter's Trade Service.*

Catalogues and Lists.—BRITISH THOMSON-HOUSTON CO., LTD., 77, Upper Thames Street, London, E.C. 4.—Descriptive List No. 10,952, dealing with thermostatic metal developed for use on thermostatically operated devices. The action of this metal may be summed up by saying that "it bends with the heat."

MESSRS. SIEMENS BROS. & CO., LTD., Palace Place Mansions, Kensington Court, W. 8.—Catalogue P 535 gives a two-page illustrated description of the Siemens ringing vibrator (pole-changer).

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—Card illustrating the "Plexsim" one-bar fire.

MESSRS. JOHNSON & PHILLIPS, Charlton, S.E. 7.—Descriptive illustrated list dealing with unit type ironclad switchgear (8 pp).

CRYSELCO, LTD., Kempston Works, Bedford.—A pamphlet with seven humorous illustrations purporting to show some of the tests undergone by "Cryselco" lamps before leaving the factory.

MESSRS. MATTHEWS & YATES, LTD., Swinton, Manchester.—List No. 22/11, "Cyclone" D.C. motor, priced and illustrated specification.

MESSRS. DRAKE & GORHAM WHOLESALE, LTD., 67, Long Acre, W.C. 2.—Pamphlet No. 274 (42 pp.), "Artistic Fittings." An illustrated and priced catalogue of electric light fittings and accessories.

MESSRS. JOHNSON & PHILLIPS, LTD., Charlton, S.E. 7.—A 16-page list of arc lamps and accessories, with prices and illustrations, and a folder dealing with lighting costs.

Calendars.—MESSRS. S. G. LEACH & CO., LTD., 26-30, Artillery Lane, London, E.C., have hit upon a calendar novelty in the shape of an electric fan through one of the blades of which, by means of revolving card disks, the day and date can be shown as long as the calendar lasts.

MESSRS. S. WOLF & CO., LTD., 115, Southwark Street, London, S.E., 1, have issued a serviceable wall calendar for 1920. Clearly printed monthly date sheets have a column of blank space set apart for daily memoranda.

From MESSRS. SMITH & CO., of 17, West Tower Street, Carlisle, we have received a wall calendar with a coloured picture in which King George appears, his attention being centred upon a crucifix that lies among the ruins in France, with a broken sword laid upon it—"Cross" and "Crown."

MESSRS. GABRIEL, WADE & ENGLISH, LTD., timber merchants, of Hull, have issued a calendar with daily cards for changing.

Whitley Councils.—At a meeting held in Edinburgh between representatives of the Corporation electrical undertakings, power companies, and employés, it was agreed to form an Industrial Council for Scotland under the Whitley scheme. The employers and the employés will each be represented by 10 members. Councillor Bruce Lindsay, Edinburgh, was appointed chairman of the Council.—*Glasgow Herald.*

Australian Exhibition.—The *Industrial Australian and Mining Standard* says that the All-Australian Peace Exhibition of Manufactures, Arts and Industries, to be held in Adelaide from March 26th to May 22nd, 1920, promises to be successful. Practically all the available floorage has been let. The exhibition will be held in the Jubilee Exhibition building and annexes, and it has been decided to erect two additional annexes. One will be allocated to the Repatriation Department, which intends making an extensive display of work by men undergoing vocational training, and the other will be utilised for general exhibits.

Clearing Office for Enemy Debts.—The Clearing Office for enemy debts provided for in the Treaty of Peace with Germany has now been established, and Mr. Egerton Spenser Grey, Senior Official Receiver in Bankruptcy, has been appointed Controller. All communications should be addressed to:—The Controller of the Clearing Office, Cornwall House, Stamford Street, S.E. 1. Notices giving instructions as to the steps to be taken for proving their claims have been sent to creditors in the United Kingdom who have registered with the Public Trustee as custodian, claims against German nationals. Notices requesting payment of their debts to the Controller have also been sent to debtors in the United Kingdom who have registered with the Public Trustee as custodian, debts owing to German nationals. Any creditor or debtor who does not receive a notice should communicate with the Controller of the Clearing Office.

Amalgamations.—It is stated that MESSRS. BRUNNER, MOND & CO., LTD., have made a proposal to the Castner-Kellner Alkali Co., for amalgamation of interests: also that a provisional agreement has been entered into between the Vulcan Boiler and General Insurance Co., whereunder that company will be acquired by the London Assurance Corporation. Messrs. Guest, Keen and Nettlefolds, Ltd., are reported to be acquiring a controlling interest in John Lysaght, Ltd.

The Cassirer Cable Works.—It is announced that the cable and rubber works of Dr. Cassirer & Co., of Berlin-Charlottenburg, have been transformed into a joint-stock company, with a share capital of 6,000,000 marks. The transaction has been carried into effect with the co-operation of the Dresden Bank and a private banking firm, each of which has a representative on the board of the new company.

Carels Fréres Developments.—The engineering firm of Carels Fréres, of Ghent, is changing its title to La Compagnie Générale d'Electricité et de Mecaniques (Procédés Thomson-Houston et Carels), and is altering its articles of association to enable it to engage in all branches of the electrical engineering industry.

Trade Announcements.—THE IVOR ELECTRICAL CO., Ltd., of 10, Kirby Street, Hatton Garden, E.C. 1, are now in a position to undertake repairs to electric motors, armatures, magnetos, &c.

MR. W. M. WILLIAMSON has removed from No. 104 to No. 184, Peckham Rye, S.E. 22, where he has larger premises.

MESSRS. HARRISON & HORSFALL have commenced business as electrical engineers and contractors at Waltham Street, Doncaster Road, Barnsley.

MESSRS. BROTHERTON TUBES & CONDUITS, LTD., have removed their Manchester office to No. 314, Corn and Produce Exchange, Cathedral Street, Manchester. The branch will be under the management of Mr. T. A. Nunwick, as formerly. Telephone number and telegraphic address unaltered.

MESSRS. SPENCER, ABBOTT & CO., LTD. coal contractors (manufacturing fuel by rail or by water), have opened offices at 8, Arthur Street, London Bridge, E.C. 4.

MR. WILLIAM GLASS, who has opened business as a mechanical and electrical engineer at Allness, Ross-shire, N.B., desires to receive catalogues of electric wiring and accessories.

Control of Electricity Prices in N.S.W.—A Bill to control the price of necessary commodities and prevent profiteering was introduced by the Government in the N.S.W. Legislative Assembly recently. In addition to fuels, electricity for lighting, heating, or industrial purposes, is included in the necessary commodities specified in the Bill.—*Tenders.*

Generating Plant for Sale.—St. James' and Pall Mall Electric Light Co., Ltd., has for disposal two Willans compound engines, coupled to two 310-KW. Siemens dynamos. For full particulars see our advertisement pages to-day.

Dissolutions and Liquidations.—H. COLTMAN & SONS, boilermakers, Meadow Lane, Loughborough.—Messrs. J. C. and E. E. Coltman have dissolved partnership.

HOLME ELECTRIC CO., LTD.—Winding up voluntarily. Liquidator, Mr. J. Alderson, of Holme. Meeting of creditors at 1, Westgate, Huddersfield, January 19th.

ARMATURE REPAIR CO., 5, Hirst Street, Liverpool.—Messrs J. Copland, W. A. McGuire, and T. Murphy have dissolved partnership. Messrs. J. Copland and W. A. McGuire will attend to debts and continue the business.

BLACKPOOL AND FLEETWOOD TRAMROAD CO.—Claims to be sent by January 31st, to Mr. J. Cameron, 75, Red Bank Road, Bispham-with-Norbeck, Blackpool.

GELL TELEGRAPHIC APPLIANCES SYNDICATE, LTD.—A meeting is called for February 19th at Sardinia House, Sardinia Street, Kingsway, W.C., to hear an account of the winding-up from the liquidator, Mr. A. F. Dickin.

GRAPHITE PLUMBAGO CRUCIBLE CO., LTD. — Winding up voluntarily. Liquidator, Mr. E. Phillips, Tanner's Hill, Deptford, S.E. 8. Meeting of creditors, January 27th.

Bankruptcy Proceedings.—F. J. HORNETT (Earle), electrician, Truro.—Trustee (Mr. G. C. Hancock, official receiver), released January 2nd.

C. HELLYAR (A. Parker & Co.), electrical engineer and contractor, 130, Upper Richmond Road, East Sheen.—Last day for proofs for dividend, January 26th. Trustee, Mr. T. Gourlay, 132, York Road, S.E. 1.

W. H. MELLON (H. B. Wallis & Co.), electrical engineer, 37, Elliott Road, Chiswick, late of 43, Turnham Green Terrace.—Receiving order made January 10th on debtor's own petition.

LIGHTING AND POWER NOTES.

Ascot.—PRICE INCREASE.—The Electricity Co. has received from the Board of Trade authority to advance the price of electricity from 9d. to 10d. per unit.

Australia.—SYDNEY.—The City Electrical Engineer calculates that by the end of the present year a further capital expenditure of £121,368 will have been made, bringing the total capital charges up to a total of nearly £4,000,000. The net profit of the Sydney undertakings for the three months, July to September, 1919, was £17,588.

TASMANIA.—The Minister of Works states that plant capable of developing 50,000 H.P. has been ordered for the Great Lake hydro-electric scheme, involving an outlay of £2,500,000, of which £1,300,000 is for the power station, £573,000 for sub-stations and transmission lines, and £200,000 for the Hobart installation. It is anticipated that the following yearly revenue will be assured:—Electrolytic Zinc Co., £60,000; Carbide Co., at Electrona, £30,000; and Hobart district, £60,000.

Bath.—LOAN.—The Ministry of Health regards the proposals contained in the Council's application to borrow £30,405 as generally satisfactory, but awaits a revised estimate based on provisionally accepted tenders.

Buxton. — LOAN. — The Town Council has decided to apply for sanction to borrow £24,379 for various improvements. These include the replacement of the existing steam plant by gas-driven machinery, at an estimated cost of £15,775.

Chesterfield.—PRICE INCREASE.—The Town Council has increased the charge for electricity for private and public lighting by an amount equivalent to 75 per cent. on pre-war prices from the last meter readings in November.

Crewe.—EXTENSION OF SUPPLY.—The Town Council has applied to the Board of Trade for an order to supply electricity to the township of Shavington.

Darwen.—LOAN.—Application has been made for sanction to borrow £27,695 for electricity extensions.

Derby.—JOINT SUPPLY SCHEME.—The Town Council had before it, at the meeting held on January 7th, the report of Messrs. J. H. Rider and C. H. Wordingham upon the proposed Midland joint supply scheme. It was found that while most of the towns would benefit by the suggested arrangements, Derby would have to pay more for energy than at present, owing to the cost of distribution. In view of this, the Joint Committee appointed to deal with the arrangements has not yet agreed to the adoption of the scheme in its entirety, but has arranged for the electrical engineers of the undertakings involved to meet and form an alternative scheme for the Committee's consideration.

Dewsbury. — BULK SUPPLY. — To meet the present shortage of electricity, the Corporation has decided to enter into arrangements with the Yorkshire Electric Power Co. for a bulk supply, and application is to be made for power to borrow £8,500 for distributive plant.

Dover.—PRICE INCREASE. — The Board of Trade has approved the Council's proposal to advance the price of electricity to 8½d. per unit from October last. The Town Council has decided to abandon free wiring as unremunerative. Prepayment meters have also proved too expensive in maintenance, and it has been decided not to install them in future.

LOAN.—The Town Council is applying for powers to borrow £20,000 for extensions and additional plant.

Dysart.—STREET LIGHTING.—The Town Council has invited offers from the Gas Co. and the Fife Electric Power Co. for the lighting of the town. The Power Co. states that it has recently laid main transmission cables through Dysart, but it will be necessary to erect a sub-station and lay distribution cables.

Glasgow.—DALMARNOCK STATION.—It was hoped to have the new power station at Dalmarnock partly in commission by the beginning of this year, but the moulders' strike has caused delay, and it is expected that three months will elapse before a start can be made.

LOAN.—The Secretary for Scotland has signified his approval of the Council's request for powers to borrow a further amount of £1,000,000 for electrical extensions. This brings the total authorised by the Secretary to £5,071,478.

It has been decided by the Council not to reduce charges for energy, upon the reduction of the price of coal, as no increase was made when coal was raised by 6s. per ton.

Hastings.—EXTENSIONS.—The Council has sanctioned several mains extensions, including one to Ore Rectory. Application has been made for a loan of £3,000—the cost of installing meters.

Isle of Wight.—PRICES.—The Electric Light and Power Co. has fixed the price for energy supplied for heating at 4d. per unit for the first 300 units per quarter, and 3d. per unit beyond.

Leith.—NEW PLANT.—The Leith Dock Commission has decided to install a 1,500-KW. turbo-generator to replace the present gas-driven plant. The cost, including the foundations and structural alterations, is estimated at £40,000.

Lewes. — PUBLIC LIGHTING. — The Town Council has sealed an agreement for public lighting with the Lewes and District Electric Supply Co.

Liverpool.—EXTENSIONS.—The Corporation proposes to apply to the Ministry of Health for sanction to the borrowing by the Council of £200,000 for the provision of additional generating plant, boilers, cooling towers, &c., in connection with the reconstruction of the Lister Drive power station.

London.—POPLAR.—New plant is needed to meet the increased demands for power. The Port of London Authority intends to erect a 3,000-KW. sub-station shortly, which the Council is being asked to supply from its mains. Although a certain amount of assistance is available from "linked-up" neighbouring supplies, an immediate expenditure of £68,080 is necessary.

Loughborough. — YEAR'S WORKING. — It is stated that the gross profit of £613 for the last year of the electricity undertaking's working is not sufficient to pay expenses. Even last year's gross profit of £2,112 was inadequate to meet the liabilities. The increases in prices which came into force recently are not considered large enough and a further 15 per cent. advance is projected.

Nelson.—NEW PLANT.—The Town Council has decided to install additional plant, at an estimated cost of £47,600. Applications have been received from cotton manufacturers for the supply of power to 1,800 looms.

New Zealand.—LAKE COLERIDGE UNDERTAKING.—The report on the fourth year's operation of the Lake Coleridge supply states that 23,387,546 units were sold to wholesale consumers at an average cost, allowing for loss in distribution, of 1·125d. per unit, compared with 1,260,725 units sold at an average price of 3·74d. per unit in 1914, the last complete year of operation of the

Christchurch City Council's steam-generating plant. The connected load has increased to 23,189 KW. This has been supplied without exceeding a maximum load on the Addington sub-station of 5,340 KW., indicating that with the nature of the load in the Christchurch district the use of energy by consumers at different periods during the 24 hours makes it possible to supply a given amount with a plant capacity of less than one-quarter the aggregate of the load connected. Of the special industrial developments associated with a supply of cheap hydro-electric power which have taken place during the year, the position is as follows:—(*a*) Iron oxide for paint, prepared electrochemically from waste sheet-iron, such as empty tins, &c. This industry has now been established on a commercial basis, and the paint is being successfully marketed. (*b*) The electrolytic production of oxygen has proved a definite commercial success. The oxygen is produced by direct electrolysis from water, the hydrogen so far not being utilised, but processes are under contemplation for using this gas in connection with the recovery of lower-grade oils and in soap manufacture. (*c*) Steel smelting: the ferro-concrete building for the works is nearing completion, and the bulk of the electrical equipment has been delivered. The installation of a six-ton 1,200-KW Heroult steel furnace by a New Zealand company is an enterprise of considerable magnitude and interest, and marks an important step in the country's industrial and electrical development.—*Auckland Weekly News.*

HORAHORA SCHEME.—It is understood that the Horahora hydro-electric power plant, recently purchased by the Government from the Waihi Gold Mining Co., was taken over by the Government early in November. The company's staff will, however, run the plant for the time being, and will probably assist with the installation of additional plant.

Richmond (Yorks.).—LIGHTING PROPOSALS.—The question of installing electric lighting in the borough is under consideration. Application has been made to the Ministry of Health, which has referred the matter to the Board of Trade.

Southend.—SUB-STATIONS.—The position with regard to the two sub-stations which were agreed upon prior to the war, is as follows:—The Leigh station was erected shortly before war broke out, and the Diesel engines were ordered and completed. The Council was urged by the Government to dispose of this plant during the war, as it was considered of greater utility elsewhere. The plant was eventually sent to Russia, where there was a shortage of such equipment. The manufacturers entered into an agreement with the Council to supply further plant upon the cessation of hostilities. This has not yet been delivered, and it is proposed to "carry on" for the time being with the four Diesels taken from enemy submarines. The Thorpe Bay sub-station was not commenced in 1914, but efforts are being made to get it running as soon as possible.

South Shields.—PROPOSED EXTENSIONS.—The Electricity Committee states that additional plant is required to meet the increased demands of consumers. The present capacity is 5,800 KW., the same as it was in 1915, and only a part of this can be considered efficient. Consumers' connections have increased from 8,015 KW. in 1915 to 11,481 KW., and in addition to this there are 110 outstanding applications and also the prospect of the early construction of a light railway in the district.

St. Helens.—LOAN.—The Ministry of Health has sanctioned the borrowing of £28,900 for the purchase of a turbo-generator and condensing plant.

Stockport.—EXTENSIONS.—The Electricity Committee is to expend £75,000 on new plant and extensions to the electricity works.

Stockton-on-Tees.—LOAN.—The Ministry of Health has sanctioned the borrowing by the Corporation of £2,500 for prospective expenditure on mains and plant.

Teignmouth.—OFFER TO COUNCIL.—Dr. Purves, who holds an order for Teignmouth electric lighting, has offered to hand it over to the Council on condition that he is allowed to do the work at a charge of 5 per cent. on cost. The Council has decided to meet Dr. Purves on the subject. Meanwhile the Council gives its support to the Dartmoor hydro-electric scheme, and urges other local bodies to take a similar course.

Torquay.—LOAN.—The Town Council has applied for a loan of £1,617 for installing new plant at Beacon Quay, and has increased the meter rental charge from 1s. 3d. to 1s. 9d. per quarter.

Tunbridge Wells.—LOANS.—The Ministry of Health has sanctioned the borrowing of amounts of £15,518 and £3,761 for electrical purposes. Permission to borrow a further sum for the purchase of plant is being withheld pending the receipt of tenders.

Todmorden.—DEFICIT.—The financial statement for the past year, just issued, shows a deficit of £3,281 on the electricity department's working.

Wigan.—SUB-STATION PLANT.—The Town Council is applying for permission to borrow £12,050 for the purchase of rotary converters, &c., for the Bradford Place and Pemberton sub-stations.

Wolverhampton.—PROPOSED EXTENSIONS.—The Electricity Committee has submitted a list of improvements and additions which, it is estimated, will cost £17,000. The largest item is the provision of transformers at a cost of £7,600, excluding the necessary switchgear and other accessories.

TRAMWAY AND RAILWAY NOTES.

Australia.—TRAMWAY RETURNS.—The revenue of the Prahran and Malvern Tramways Trust for the year ended September 30th, 1919, was £214,728, an advance of £10,036 upon the previous year's figure. The last month of the period produced receipts totalling £19,996, a record figure.

Blackpool.—YEAR'S WORKING.—The annual report of the general manager of the Corporation tramways for the year ended March 31st, 1919, gives the following figures:—Total income, £144,535; total expenditure, £93,639, leaving a gross profit of £50,896. Net profit, after deduction of loan interest and taxes, was £37,580, a decrease of £255 on last year's figure. The number of passengers carried was 25,548,753, and the total energy employed was 2,137,716 units.

Further extensions of the tramways have been approved by a majority of ratepayers.

Burnley.—BULK SUPPLY.—The Council has received an application from Nelson Corporation for the supply of power for traction purposes. It has been decided to accede to this request if the Nelson Corporation will replace the coal consumed in generating the energy supplied.

Darlington.—STORM DAMAGE.—During a gale on January 8th, a tree was blown against an electric standard, and both fell across the roadway, breaking the overhead wires. Tramway traffic was suspended for several hours.

Halifax.—The proposal to construct tramway lines in Southgate was deleted from the Corporation Bill at a ratepayers meeting last week. The proposal to extend the tramway system to Elland and Wood Bottom, and thereby join up with the Todmorden 'bus service, was carried, as was also the power to increase the fares from 1d. to 2d. per mile, and to alter the gauge.

Leeds.—WORKMEN'S FARES.—It was stated at the meeting of the Town Council held last week, that a heavy loss was resulting from the running of workmen's cars at cheap fares. The annual loss was at the rate of £44,565. An attempt by one of the Labour members of the Council to extend the cheap fare limit from 7.45 to 8.45 a.m. failed.

London.—UNDERGROUND EXTENSION.—The Central London Railway Co. is applying for power to construct a branch line linking up the system with that of the London and South-Western Railway Co., at a point near the latter's Shepherd's Bush station. The necessary capital is being raised by the issue of £374,000 debenture stock. The Bill imposes upon the company a penalty of £50 a day if the stipulated time for construction is exceeded, to be applied as compensation to landowners and others affected.

EXTENSIONS OPPOSED.—Strong opposition is being offered by London local authorities to the London County Council Tramways and Improvements Bill which is being promoted for next session. Among those who have deposited memorials asking to be heard against the Bill are the City of Westminster, the City Corporation, the Boroughs of Hammersmith, Lewisham, Southwark, Paddington, Holborn, Lambeth, St. Marylebone, St. Pancras and Hampstead, and the Urban District Councils of Beckenham, Willesden, and Penge.

Memorials have been received from the Borough of Hampstead and the Willesden Urban District Council in opposition to the Bill promoted by the Middlesex County Council for proposed tramways and other improvements.

Middlesex.—TRAMWAY EXTENSIONS.—The County Council has deposited a Bill for next session which, if passed, will enable the Council to raise £1,000,000 by the issue of county stock. This sum is to be expended upon the construction of a tramway route along the Kilburn High Road, and also for the provision of motor-omnibuses in the county and metropolitan districts.

Newcastle.—PROTEST AGAINST BILL.—At a meeting of the City Council, on the 7th inst., it was decided to petition against the Tyneside Tramways and Tramroads Co.'s Bill. The company is seeking power, *inter alia*, to run omnibuses from Gosforth Park to Seaton Burn, and on other country roads in Northumberland. The Corporation is also seeking power to run 'buses to Seaton Burn, and claims a prior right to operate this service.

Salford.—YEAR'S WORKING.—The report upon the undertaking for the year ended March 31st, 1919, shows total income, £419,181; total expenditure, £294,501; leaving a gross profit of £124,680. The deduction of interest on loans, rents, &c., leaves a net profit of £25,000. The total mileage of the system is 74·8, and the number of units used during the year was 10,666,672. One item of expenditure (£23,867), represented the amount paid to employés serving with H.M. Forces.

St. Helens.—TRANSFER OF SYSTEM.—The Tramways Committee is taking over the undertaking and also an existing debt of £5,000, and is expected to produce £1,000 per annum while bearing the whole cost of repairs and maintenance. The charge for energy has been fixed at 1·50d. per unit, subject to an increase or decrease of 0·03d. for each rise or fall of 1s. per ton in the price of coal, at present 30s.

St. Annes.—TRAMWAY PURCHASE.—The Urban District Council and a public meeting have passed resolutions confirming the proposal to promote a Bill in Parliament for the acquisition of the undertaking of the Blackpool, St. Annes and Lytham Tramways Co., Ltd., in the St. Annes and Lytham area.

Stoke-on-Trent.—TRAMWAY PURCHASE.—The Council proposes to promote a Parliamentary Bill to enable it to acquire and work the district tramways, light railways and omnibuses. The Town Committee, a body comprising the leading citizens, approves of the scheme, but considers the proposed purchase price excessive.

Yorkshire.—FARE INCREASE.—The Dewsbury and Batley Corporations are combining to oppose an application of the Yorkshire (Woollen District) Electric Tramways, Ltd., for an order authorising increased fares.

TELEGRAPH AND TELEPHONE NOTES.

Cable Rates and Censorship.—Telegrams will now be accepted for Hungary at 4d. a word. Telegrams are liable to censorship in Hungary, and can, therefore, be sent at sender's risk only. Deferred telegrams for Kismayu, British East Africa, will now be accepted at the rate of 1s. 7½d. a word. All previous notices as to the abolition of censorship on telegrams to places abroad are cancelled. Telegrams for all places abroad (with certain exceptions, which may be ascertained at any post office), may now be accepted without restriction, in accordance with the general arrangements in force before the war.

Egypt.—Regarding the cable delays, there was, according to the *Egyptian Gazette*, in the middle of December, a waiting list of 18,000 messages at Alexandria, and at Suez a similar collection of 12,000. These were being dispatched as quickly as possible, but the fresh ones sustained the waiting list, as described.

Italy.—A special wireless service between England and Italy for the use of the Press was opened on January 6th, by the Marconi Co. This service, authorised by the Italian Government and the British Post Office, was instituted particularly to assist the Italian Press in obtaining prompt reports of the Italian Prime Minister's visit to London. The Marconi high-powered station at Carnarvon is being used for the purpose, and three hours daily have been allotted for this particular traffic.

Storm Damage.—There was a breakdown of the overland telegraph lines to the Continent, on January 10th, which interrupted the cross-Channel cables. The main interruption of the land lines was reported on Saturday afternoon near Tunbridge Wells, on the London-Dover route, but soon after 9 o'clock communication with France was resumed, and later with Holland, but not with Germany.

Much damage was caused by the week-end storm to telegraph and telephone systems, not only in England, but all over Western Europe. Communication with Ireland and the Continent, on Monday, could only be carried on by roundabout routes and with much delay. Rome, Marseilles, and Zurich were completely isolated from London.

Wireless Meteorological Information.—The *London Gazette*, January 6th, contains an Admiralty Notice to Mariners, No. 8, of 1920, which cancels the former notice, No. 1,393, of 1919, relating to wireless meteorological information to and from ships at sea. It is hoped that all concerned will assist in making this service a success; negotiations are in hand to extend and unify the system of collecting weather data by wireless from ships at sea all over the world, and at the same time to organise the free transmission of weather bulletins to admit of ships being constantly supplied with reliable weather reports and forecasts wherever they may be. The need of ships at sea regarding information about the weather will march hand-in-hand with the requirements of aircraft, and the importance of the service will, therefore, be constantly increasing. The essence of success lies in rapidity in passing on wireless data collected by ships to the coast stations, and thence to the central meteorological office.

Wireless Service Suspended.—The Marconi wireless telegraphic service to the U.S.A. and Newfoundland has been temporarily suspended, says the *Financial Times*, due to a matter affecting an agreement with the Western Union Cable Co.

Wireless Telephony.—According to the daily Press the Marconi Co. is about to demonstrate a use for wireless telephony in aerial navigation by the employment on an airway route of direction-finding stations. The company also has made successful experiments in wireless telephony between Chelmsford and a station 20 miles east of Amsterdam, with portable sets that can be carried on mules.

Wireless Time Signals.—The *London Gazette*, January 6th, contains an Admiralty notice to mariners, No. 7, of 1920, which cancels the former notice No. 1,993, of 1919, giving general information with regard to wireless time signals, also a complete and up-to-date list of all time signals issued by wireless stations throughout the world.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—January 31st. Electricity Committee. Two water-tube boilers, with superheaters, economisers, steel chimney and accessories. (January 9th.)

Aldershot.—January 20th. Urban District Council. Electricity Department. Renewal of 180 positive sections for batteries. (See this issue.)

Australia.—SYDNEY.—February 18th. One electrically-controlled tower clock and four dials, for Sydney sub-station. Chief Electrical Engineer's Office, 61, Hunter Street, Sydney.

March 1st. Municipal Council. Supply of 2,000-K.V.A., 5,000 to 10,000-v. transformers. Electric Lighting Department, Town Hall.

PERTH, W.A.—February 10th. P.M.G.'s Department. 340 accumulators (schedule W.A.647.) (December 19th.)

MELBOURNE.—February 25th. Victorian Railways. Incandescent electric lamps. Particulars from the Contractor's Room Spencer Street, Melbourne.

March 10th. City Council. Supply of 6,600-v. switchgear for sub-station switch houses, &c., and of six 250-K.V.A., three-phase transformers. Specifications from City Electrical Engineers' Office, Melbourne.—*Industrial Australian and Mining Standard.*

Bray.—January 30th. Urban District Council. Electricity Works. One 200-B.H.P. Diesel engine, direct coupled to a 135-K.V.A. single-phase alternator and exciter. (January 9th.)

Barnes.—January 20th. Urban District Council. Electricity Department. Supply of water-tube boilers, economisers, draught plant, turbo-alternators, condensers, air and circulating pumps, transformers and rotary converters. (December 12th.)

Battersea.—January 21st. Borough Council. One 5,000-KW. turbo-alternator, with condensing plant; one 1,500-KW. rotary converter; pipework for the 5,000-KW. turbo-alternator; switchgear for the 5,000-KW. turbo-alternator and 1,500-KW. rotary converter. (January 2nd.)

Bradford.—January 28th. Corporation. Two electric battery locomotives. (December 26th.)

Chile.—March 15th. Comision de Puertos, Santiago. Electrical machinery (power and lighting) for the Port of Valparaiso. Comision de Puertos, Santiago, Chile. Copies of the specifications can be seen at the Chilean Legation, 94, Gracechurch Street, London, between 3 and 5 p.m.

Colne.—Electricity Department. New or second-hand 1,250-KW. to 2,000-KW., 6,600-v. turbo-alternator, with condensing plant. (See this issue.)

Dundee.—January 23rd. Corporation. Electricity Department. Three 750-KW. converter sets; one 300-KW. ditto; 11,000 v., E.H.T. switchboard; two 750-KW., D.C. control panels; one 300-KW. ditto. (December 19th.)

Edinburgh.—February 9th. Electricity Supply Department. One overhead travelling crane. (See this issue.)

Ilford.—January 27th. Urban District Council. Electricity Department. One 1,000-KW. converting plant, cooling tower, motor-driven air compressor, L.T. cables. (January 9th.)

Kingston-upon-Hull.—January 23rd. Electricity Committee. One 10,000-KW. turbo-alternator, with exciter, and one condenser outfit complete. (January 2nd.)

London.—ISLINGTON.—January 28th. Electricity Committee. Stores, including cables, meters, electric lamps, &c., for 12 months. (December 19th.)

HAMMERSMITH.—January 20th. Electricity Department. Wiring schemes for small property, boiler setting and furnace work, &c. (January 9th.)

STEPNEY.—January 22nd. Electricity Supply Committee Two water-tube boilers, chimneys, economisers, &c., and one 5,000-KW. turbo-alternator, with condenser, accessories and switchgear. (December 19th.)

HAMPSTEAD.—January 28th. Borough Council. 12 months' supply of electrical engineers' stores; 6 or 12 months' supply of oils for the electricity station. Forms of tender from Mr. A. P. Johnston, Town Clerk, Town Hall, Haverstock Hill, N.W.3.

CAMBERWELL.—February 2nd. Borough Council. 12 months, maintenance of the private telephones and electric bells at the Town Hall. Mr. F. J. Slater, Borough Engineer, Town Hall, Camberwell, S.E.

New Zealand.—AUCKLAND.—September 1st. Harbour Board. 12 5-ton (and alternatively for 12 3-ton) semi-portable balanced jib level Luffing electric cranes. Specifications from the Agents of the Board, Messrs. W. & A. McArthur, Ltd., 18/19, Silk Street, Cripplegate, E.C.

Pontypridd.—January 30th. Urban District Council. Electricity Department. Rotary converter, transformer and switchgear. (January 9th.)

Venezuela.—June 30th. The Government *Gazette* of Venezuela publishes a decree inviting tenders for the installation of a wireless telegraphic station near Caracas. (See this column for January 2nd.)

Whitby.—January 30th. Urban District Council. Turbo-alternator, condenser, air and circulating pumps, water-tube boiler, rotary converter, transformer, A.C. switchboard, E.H.T. cables. (See this issue.)

York.—January 20th. Electricity Committee. Tenders for the carrying-out of a hydro-electric scheme at Linton Lock. (January 9th.)

CLOSED.

Australia.—Sydney.—City Council. Accepted :—

Sub-station switchgear for Palmer Street sub-station £1,756.
" " Bulwarra Lane; " 954.
" " Irvine Street " 954.
Metropolitan-Vickers Electrical Co., Ltd.—*Tenders.*

Glasgow.—The Tramways Committee has accepted the following offers :—

Aluminium ribbon.—Coe Ribbon Gold Leaf Manufacturing Co.
3-in., single-way, fireclay ducts.—Doulton & Co., Ltd.
·102 D.C.C. wire.—London Electric Wire Co. and Smiths, Ltd.

The Tramways Manager is to report upon offers received for the supply of a rotary converter for the Dalhousie Street sub-station, and inspect types submitted.

London.—STEPNEY.—The Electricity Committee has accepted the offer of Messrs. Foster & Co. to supply 13,000 tons of coal at prices varying from 34s. 1d. to 35s. 4d. a ton.

Two new converters, £11,800, Bruce Peebles & Co., recommended.

Troughs, covers and earthenware pipes :—

Sutton & Co.	(recom.)	**£254**
Siemens Bros. & Co.	.. ..	£267

HACKNEY.—Public Health Committee. Recommended. Special plant in connection with the charging station for electric vehicles :—

250-amp., 110-v. motor-generator :—

	R.P.M.	£
Lancashire Dynamo & Motor Co.	780	475
" "	1,000	445
J.H. Holmes & Co.	900	445
Electromotors, Ltd.	710	433
B.T.H. Co.	815	415
Electric Construction Co.	1,300	280
" " .. (recom.) ..	1,000	330

Charging gear :—

Lancashire Dynamo & Motor Co.	£639
J. H. Holmes & Co.	480
Igranic Electric Co. .. .. (recom.)	**435**

Nelson.—Town Council :—

Generating machinery, £47,600.—Brush Electrical Engineering Co.

Tasmania.—LAUNCESTON.—City Council.

One battery complete with spares and instruments (Australian manufacture) delivery in 26 weeks, £3,529.—Accumulators, Ltd.

No tender was accepted for the booster equipment owing to the abnormally high prices.—*Tenders.*

Wolverhampton.—Town Council. Accepted :—

Two K.V.A. transformers, £456.—Brush Electrical Engineering Co., Ltd.
Wheel lathe, £940.—Wirth & Co.
Power press, £665.—Leeds Engineering Co.
Consumers' meters, £495.—Chamberlain & Hookham, Ltd.

FORTHCOMING EVENTS.

Association of Engineers-in-Charge.—Saturday, January 17th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Social and dance.

Salford Technical and Engineering Association.—Saturday, January 17th. At the Royal Technical Institute. At 7 p.m. Presidential address by Mr. J. Morris, and musical evening.

Institution of Post Office Electrical Engineers (London Centre).—Monday, January 19th. At 5.30 p.m. At the Royal Society of Arts. Lectures on "Victory Line to Germany," by Major H. Brown; "Evacuation of Helles," by Major Turner; "Buried Cable Works," by Capt. Reid.

Royal Institution of Great Britain.—Tuesday, January 20th. At Albemarle Street, W. At 3 p.m. Lecture by Sir John Cadman.
Friday, January 23rd. At 9 p.m. Lecture on "Researches at High Pressures and Temperatures," by Sir Chas. Parsons, F.R.S.

Society of Technical Engineers (North-Eastern District).—Wednesday, January 21st. At the City Hotel, Newcastle-on-Tyne. At 7 p.m. Mass meeting.

Junior Institution of Engineers.—Friday, January 23nd. At 39, Victoria Street. At 7.30 p.m. Paper on "Evaporation in the Chemical Industry," by Mr. J. A. Reavell.

Institution of Electrical Engineers.—Thursday, January 22nd. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Paper on "Transformers for Electric Furnaces," by Mr. J. L. Thompson.
Informal meeting. Monday, January 19th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Discussion on "Functions of a Trade Journal," to be opened by Mr. F. H. Masters, O.B.E.
(**North-Western Centre—Liverpool Sub-Centre.**)—Monday, January 19th. At the University, Liverpool. At 5.30 p.m. Lecture on "The Application of Electric Power on Board Ship," by Mr. C. H. Wordingham, C.B.E. At 7 p.m. Chairman's (Prof. E. W. Marchant) address, also addresses by the President, Mr. C. H. Wordingham, and Mr. J. A. Robertson.

Institution of Mechanical Engineers—Friday, January 23rd. At Storey's Gate, S.W. At 6 p.m. Paper on "Recent Advances in Utilisation of Water Power," by Mr. E. M. Bergstrom.

Electrical Power Engineers' Association (West Yorks. Section).—Saturday, January 24th. At the Y.M.C.A., Albion Place, Leeds. At 6.45 p.m. Lecture on "The Legitimate Sphere of Trade Unionism," by Mr. F. Kirkley.

Royal Photographic Society, Russell Square, W.—Exhibition of prints lent by the Röntgen Society. Open till February 7th.

NOTES.

The 10s. Coal Rebate.—We are informed by the secretary of the Provincial Electric Supply Committee of the United Kingdom that he has, at the request of the Coal Controller, sent to electricity supply companies 200 copies of the printed prescription issued by the Board of Trade with reference to obtaining and passing on to the consumer the rebate of 10s. per ton on coal used for generating electricity sold for domestic or household purposes, together with an explanatory memorandum approved by the Coal Controller. In case, however, any particular undertaking has not received a copy, one may be had on application to Mr. T. W. Cole, secretary of the above Committee, at Moorgate Court, Moorgate Place, London, E.C. 2. The prescription is printed on p. 75, with an abstract of the explanatory memorandum.

Central-Station Salaries.—A recent issue of *Power* gives the undermentioned details of the salaries paid to the various classes of typical central-station employés in the U.S.A. :—

SALARIES IN CENTRAL STATIONS.

Capacity in KW.	Chief engineer.	Watch engineers.	Oilers.	Firemen.	Chief electricians.	Electricians.	Sw.-board operators.	Pipe fitters.	Labourers.
35,000	250	175	156	156	225	154	135	134	104
30,000	185	135	—	130	145	118	112	140	—
24,000	208	108	104	—	114	104	127	104	89
15,000	275	173	154	142	—	—	132	228?	120
11,250	225	140	115	120	—	180	120	120	93
6,000	300	180	150	180	175	145	—	165	110
2,000	150	120	—	115	150	85	—	—	—
670	152	105	104	—	—	—	—	—	—
425	160	122	—	108	—	—	—	—	—

Salaries in dollars per month.

A "Live" Lorry.—It is reported from Wallsall that a Foden steam wagon became electrically "live" whilst standing on the roadway, and the driver complained to the motorman of a passing tramcar that he thought the energy was coming from the tramway system. On touching metal parts of the steam engine, a shock was felt, yet there was no contact either with the tramway rails or a pole. The motorman, however, noticed that steam from the wagon was ascending directly to the tramway wires, and on the steam being shut off, no further shocks were perceptible. It is presumed that the current from the wires travelled down the column of vapour.

The Patents and Designs Act.—The Patents and Designs Act, which became law on December 23rd, 1919, makes numerous alterations in the British patent law, of which the following are those of most general interest to inventors and patentees :—

1. The period of provisional protection is increased to nine months. Any application, therefore, accompanied by a provisional specification, and lodged subsequent to March, 1919, may be completed within nine months of the date of application, or, by the payment of a fine, within 10 months.

2. The term of a patent is increased to 16 years. This applies to all patents on applications dated December 23rd, 1905, or later. The fees, if any, to be paid for the fifteenth and sixteenth years are not yet fixed.

3. A patentee, other than a late enemy, who has by reason of the war suffered loss or damage (including loss of opportunity of dealing with or developing his invention, owing to his having been engaged in work of national importance connected with the war), may apply in a simpler and cheaper manner than was before possible for a prolongation of the term of his patent, and the Court in considering the application, may have regard solely to such loss or damage.

4. Any person who has acquired, or may acquire, by assignment, licence, or the like, any interest in a patent or design, must register his interest at the Patent Office.

5. The grounds on which the grant of a patent may be opposed are enlarged. Such grant may now be opposed on the ground that the invention has been published in any document published in the United Kingdom prior to the application.

6 (*not yet in force*). At any time after the sealing of a patent, the patentee may request the Comptroller to endorse the patent with the words "Licences of right." The Comptroller, on being satisfied that the patentee is not precluded from making such request, will so endorse the patent, and thereafter the patentee will only have to pay half the normal renewal fees, but any person who wishes to use the invention will have the right to a licence on terms to be settled by the Comptroller in default of agreement between such persons and the patentee, and the Comptroller may, in order to secure equality of advantage among several licencees, reduce the royalties payable under any licence previously granted.

7 (*not yet in force*). Somewhat drastic provisions as regards the grant of compulsory licences and revocation have been substituted for Sec. 27 of the old Act, the so-called "working" section.

8. Under certain conditions publication of an invention in a paper read before a learned society does not invalidate a patent subsequently applied for. This provision, however, is fraught with the greatest danger, and should not be taken advantage of without professional advice.

9. No person other than a registered patent agent may now practice, describe, or hold himself out as a patent agent.

The foregoing summary has been drawn up by the Council of the Chartered institute of Patent Agents.

H.M.S. Hood.—On January 9th *H.M.S. Hood*, the latest British capital ship, left Messrs. John Brown's Clydebank yard for her official trials. She is to be completed at Rosyth, and it is understood that she will replace *H.M.S. Queen Elizabeth* as flagship of the Atlantic Fleet. Possibly the new *Hood* will be the last of her kind; there are no other capital ships under construction for the British Navy. This vessel, on which electricity is made use of extensively, is a blend of battleship and battle cruiser; she embodies all the lessons of the war, including "blister" protection against torpedo attack. She is 860 ft. long, displaces 41,200 tons, has a horse-power of 144,000, and a designed speed of 31 knots. Her main armament consists of eight 15-in. guns, and her secondary armament of 12 5·5-in. and four 4-in. anti-aircraft guns. When completed for sea, the *Hood* will have cost £6,025,000, and the annual cost of her maintenance in commission will be £539,000.—*Evening News.*

The Slough Motor Depôt.—In view of the fact that our note last week on the above depôt might be read as if the Benjamin Electric, Ltd., was carrying out the electrical installation, we wish to make it quite clear that, while Benjamin reflector fittings, and reflectors are being used throughout for interior lighting, the installation work is being carried out by Messrs. Dixon & Sons, Ltd., of Leeds, Messrs. Malcolm & Allen, and Messrs. Foote & Milne, of London.

The "Threat" to Dartmoor.—In a letter to *The Times* of January 10th, Mr. J. E. Addinsell, secretary, the Wilson Syndicate, Ltd., points out that the Dartmoor and District Hydro-Electric Supply Bill is a Bill which the Wilson Syndicate have taken over from its original sponsors, and to every detail of which they are not wedded. It will be quite possible in Committee to safeguard the desire, with which the promoters sympathise, to preserve the historic monuments and the amenities of Dartmoor. Thus, for example, there is no intention to submerge the stones of Scorhill Circle, about the destruction of which so much has been said. Again, there will be no generating station and consequently no disfiguring poles on the moor itself.

With regard to the proposed metal works in the neighbourhood of Newton Abbot, most of the criticism of these is based on a complete misconception. The works are to be situated in a spot already so "industrialised" that there can be no question of spoiling its beauty. It is not the intention of the promoters to use any processes which will cause destruction to the surrounding vegetation. The methods which will be employed at these works will be such as to ensure a total absence of any noxious fumes or any gases which might be deleterious to vegetation, even to the extent that there will not be any smoke whatsoever.

Further, with reference to the objections raised to the proposed copper refining, blister copper, and not copper ore, is the raw material which will be used, and this material will be sulphur free.

We recently explained that the use of the water power would not necessarily interfere with the amenities of the district.

Training of Disabled Men.—Satisfactory progress with regard to the training of ex-service men in the West Midland area, of which Birmingham is the centre, is reported by the Divisional Director. The men in training total 922 in Birmingham, and 220 in country areas; making aggregates of 1,146 and 414 respectively. There are still 1,272 awaiting industrial training. Forty-six men are learning electrical engineering, either in technical school or workshop; a figure which compares well with other industries.

A B.T.H. Dinner.—The annual dinner of the B.T.H. Co.'s testing department will be held on the third or fourth Saturday in February. The Committee trusts that all past members of the department will endeavour to attend. Application for tickets should be sent as soon as possible so that final arrangements can be made to Mr. K. R. Hopkirk, c/o Testing Department, B.T.H. Co., Rugby.

Appointments Vacant.—Shift engineer (£264) for the Accrington Corporation Electricity Department; cable jointer (78s. + 12½ per cent.), for the Wrexham Corporation Electricity Works; lecturer in electrical engineering (£350, rising to £400), for the Faculty of Engineering, Merchant Venturers' Technical College, Bristol; assistant electrical engineer ($3.600 + $720, equal to £504 per annum, dollar = 2s. 4d.), for the Municipal Commissioners of Singapore; instrument maker (£300), for the East London College; two vacancies in the Electrical Engineering Department (Telegraphs) (600 rupees a month) in the Bombay and Baroda and Central India Railway, India; shift engineer (£4), for the Torquay Corporation Electrical Department; assistant mains engineer (£260), for the City of Coventry Electricity Department; traffic superintendent (£275); and rolling stock superintendent (£275), for the Wigan Corporation Tramways; charge shift engineer (£250 + 20 per cent. + £90), for the L.C.C. Tramways Department; mains superintendent (62/6 + 20 per cent. + £90), for the Tynemouth Corporation Electricity Works; switchboard attendant (37/6 + 33/6 + 12½ per cent.), for the Lancaster Corporation Electricity Department; assistant telegraph engineers (£250 + £65, for single men, and £115 for married men), for the Government of Uganda; Principal of L.C.C. Training Centre for disabled sailors and soldiers in the electrical and engineering trades at Hackney Marshes (£600).—See "Official Notices" to-day.

Volunteer Notes.—COUNTY OF LONDON R.E. (V.) LONDON ARMY TROOPS COMPANIES.—A cheque for £94 8s. 5d., being the balance of the funds of No. 3 Co. Royal Engineers (V.), London Army Troops Companies (Engineering Institutions Company), has been forwarded to Sir John Snell, for distribution to the Benevolent Funds of the three Engineering Institutions, in accordance with the arrangement made when subscriptions were invited.

Joint Electricity Authorities.—GLOUCESTERSHIRE.—At a meeting of the Gloucestershire County Council, on January 12th, the proposed formation of a joint electricity authority for the county and parts of Wilts and Monmouthshire was discussed. The chairman stated that the Ministry of Shipping was anxious to dispose of the generating station at the Government works at Beachley, which could be used to supply the Forest of Dean district west of the Severn; other schemes were being brought forward for the supply of electricity to the Forest of Dean mines. With Mr. Gardom he had attended a meeting at Bristol, at which certain resolutions (reported in our pages last week) were passed, and he asked the Council to adopt them. The resolutions expressed agreement with the formation of a joint electricity authority, with forming part of such authority, with contributing to the expenses, and with the appointment of an Organising Committee to prepare a scheme. The resolutions were adopted.

At a meeting of the Organising Committee, on Friday last, Mr. H. Faraday Proctor was elected chairman.

SOMERSET.—At a meeting of the Somerset County Council, held on Friday last, resolutions expressing agreement with the formation of a joint electricity authority were adopted.

Housing and Transport.—Addressing the members of the Auctioneers' and Estate Agents' Institute, on Friday last, on "Some Aspects of the Housing Problem," Mr. Frank Hunt, Chief Valuer of the London County Council, said that hitherto the traffic at cheap workmen's fares ceased on arrival at the London terminus at 8 o'clock, and there was another traffic peak period extending up to 10 o'clock. The alteration in the hours of labour had tended to cause these two traffics to coalesce, and to be compressed into a shorter period; and this also operated in a somewhat similar way at the other end of the day. There was no doubt that considerable improvements would be needed in the methods of transport, and he thought the present lack of system, whereby there seemed to be no co-ordinated action to use the various instruments of transport for the purposes for which they were best adapted, would need to be superseded by an intelligent system. When the various systems of transport in big towns were scientifically organised, it would be found most convenient to run the trains to nodal stations, and to organise around those stations systems of surface transport.

I.M.E.A. Convention.—The *Yorkshire Observer* states that the annual convention of the Incorporated Municipal Electrical Association is to be held in Bradford in June next, and a special Sub-Committee of the Bradford Electricity Committee has been appointed to make all the necessary local arrangements.

Memorial Tablet at Stuart Street.—On January 11th the Lord Mayor of Manchester unveiled at Stuart Street generating station a memorial tablet, bearing the names of all employés of the station who volunteered for service in the war and laid down their lives. The names are 25 in number out of 212 who joined up from the works.

Electricity to the Rescue.—At Newcastle-under-Lyme the annual New Year's Fair was held, last week, on a piece of land adjacent to the electricity supply station. Shortly before 1 o'clock on the Monday, Mr. Pat Collins's representatives came to the works in great distress, saying that their engine had broken down, and unless something could be done for them there would be no Fair, as the place would be in darkness after sunset. Mr. A. J. C. de Renzi, the borough electrical engineer, immediately got to work, and had a pair of leads run from the switchboard of the scenic railway to a small motor-generator which was used in the ordinary way as a milking booster. By 5 p.m. everthing was connected up, and a supply of 150 amperes was given, enabling the whole of the shows to run with the usual blaze of light which is such a prominent feature of festivities of this kind. Quick work!

It is interesting to note that the motor-generator referred to above was installed chiefly for the purpose of charging battery vehicles. The town being situated on the main road between London, Birmingham, Manchester, and the North, there is an enormous amount of motor traffic passing through daily, and the electricity department has already given a charge to a number of electric vehicles going through from Birmingham to places in the North. A vehicle can be put on charge within five minutes from the time it enters the works. When such charging facilities are provided everywhere, the one obstacle to the use of "electrics" for long-distance runs will be removed.

A Red Rag to John Bull.—Since our leading article on page 65 of this issue was written, Mr. Edward Price Bell, of the *Chicago Daily News* London Bureau, has expressed in a letter to *The Times* some most admirable sentiments on the task of educating mankind internationally. Under the title "Light and Leading," he says that practically everybody everywhere is occupied with the all but overwhelming problem of giving the world "a happy peace—the only kind of peace that can last." While we cannot hold Mr. Bell answerable for all the utterances of men like Mr. Montague, it is not inconceivable that he might be able to use his newspaper influence to prevent indiscretions which cannot make for "happy" international peace and harmony in respect of trade. Perhaps he will be expressing his views on the application of his most noble sentiments in connection with international trading relations.

Signal Experimental Ship.—The steam and electrical trials of the cruiser *Antrim* are to be carried out from the 12th to 17th inst. On February 18th the vessel will commission as an independent command, with a special complement drawn from Portsmouth, for service as signal and wireless experimental ship at Portsmouth.—*Morning Post.*

INSTITUTION NOTES.

Salford Technical and Engineering Association.—The first meeting on the new syllabus will be held on January 17th, when the Presidential address will be given, after which the meeting will resolve into a musical social evening. On March 13th, Mr. D. H. Ogley will read a paper on "Works Lighting," and the "Barton Electric Power Station" will form the subject of a paper by Mr. S. L. Pearce on September 11th. A reunion of members will be held on November 13th to celebrate the home-coming of the "boys"; the annual general meeting will be held on December 4t h and the annual social on December 27th.

Institute of Metals.—The programme of meetings shows how the Birmingham, Sheffield and Scottish local sections of the Institute are developing; the membership of the Institution is now over 1,200. The annual general meeting will be held on March 11th and 12th, the annual dinner is also to be held on the latter day.

Institution of Electrical Engineers.—The first meeting of the Liverpool sub-centre will be held on January 19th at the University, Liverpool; Mr. Roger T. Smith (president), Mr. C. H. Wordingham, C.B.E. (past president), and Mr. J. A. Robertson (chairman N.-W. Centre), will address the meeting. Prof. E. W. Marchant, D.Sc. (chairman, Liverpool sub-centre), will deliver the chairman's address, and there will be demonstrations in wireless telephony and telegraphy. Mr. C. H. Wordingham will lecture on "The Application of Electric Power on Board Ship," at 5.30 p.m. This meeting is called to inaugurate the new Liverpool sub-centre, and it is hoped that there will be a good attendance from all parts.

Barrow and District Association of Engineers.—Mr. H. Thackeray, A.M.I.C.E., read a paper on "Fuel Economy and the Use of the Large Gas Engine," before a meeting of the Association on January 9th. The subjects were exhaustively dealt with by the speaker, who emphasised the need for large ironworks to utilise or recover all the by-products from their blast furnaces. He reminded his audience that Middlesbrough was supplied with gas from the coke ovens of local ironworks. Referring to the subject of gas engines, Mr. Thackeray gave particulars of an 1,800-B.H.P. horizontal tandem engine at present under construction at the works of Messrs. Vickers, Ltd. This engine is of the four-cycle, double-acting type, with 43-in. diameter cylinders, and a stroke of 47½ in. At normal load the I.H.P. is 1,970, with a mean pressure of 60 lb. per sq. in. and a speed of 100 R.P.M. It is designed for driving either a D.C. generator of 1,150-KW. capacity (230 volts, 5,000 amperes), or an A.C. 1,200-KW. generator. Alternatively it may be coupled to a reciprocating blower with a capacity of 27,000 cb. ft. of air per minute,

Birmingham and District Electric Club.—At a meeting held on January 10th, Mr. Wolton, A.M.I.E.E., A.M.I.M.E., the new president, delivered his inaugural address. The speaker, commenting upon present industrial unrest, said that the stabilising forces present during the war were still needed during the period of reconstruction. He thought that the Electricity (Supply) Act carried with it enormous possibilities in the direction of cheap power supply. In conclusion, Mr. Wolton suggested the formation of an Engineers' Club to provide a meeting place for engineers of all branches.

Mr. R. A. Chattock, proposing a vote of thanks to the speaker, said that his experience led him to hope that Industrial Councils would be instrumental in solving labour troubles. Referring to the Electricity Act, the speaker said that reorganisation had already commenced, and in a short time the progress would be plainly seen.

Institution of Civil Engineers.—The Council has arranged for the delivery to students of the Institution in London and at some of the Local Associations of two Vernon-Harcourt lectures, by Mr. R. B. Dunwoody, Assoc.M.Inst.C.E., on "The Economic Requirements for Inland Navigation Transport in the British Isles." The lectures will be delivered to London students at the Institution on January 16th and 30th, at 6 p.m.

Faraday Society.—At the annual general meeting, on Dec. 15th, 1919, the following officers and Members of Council were elected to serve for the ensuing year :—

President.—Sir Robert Hadfield, Bart., F.R.S.

Vice-Presidents.—W. R. Cooper, Prof. F. G. Donnan, F.R.S., E. Hatschek, Prof. A. W. Porter, F.R.S., E. W. Rayner.

Treasurer.—Robert L. Mond, F.R.S.E.

Council.—Dr. J. Allmand, Dr. H. Borns, Prof. C. H. Desch, Dr. J. A. Harker, O.B.E., F.R.S., Cosmo Johns, Harold Moore, Prof. J. R. Partington, Dr. W. Rosenhain, F.R.S., Sir T. Kirke Rose, Dr. George Senter.

On March 1st, 1920, the Society will hold a joint meeting with the London Section of the Society of Chemical Industry to receive and discuss a report by Dr. T. Martin Lowry, F.R.S., and Mr. E. C. Hemmings on "The Setting of Salts and other Crystalline Substances."

On March 23rd, 1920, the Society will hold a general discussion on "Basic Slag from the Metallurgical and Agricultural Standpoints."

Wireless Society of London.—The next general meeting will be held on January 29th, at 6 p.m., at the Institution of Civil Engineers, when a lecture, illustrated by experiments and lantern slides, will be given by Mr. R. C. Clinker, entitled "A Portable Valve Set and Some Properties of C.W. Circuits."

A number of provincial Wireless Clubs and Societies have signified their desire to become affiliated to the Society.

South African Institute of Electrical Engineers.—A special general meeting of the South African Institute was held at Johannesburg on November 20th, 1919, for the purpose of considering and, if approved, adopting with or without further amendments, certain amendments and alterations to the constitution and rules proposed by the council. Mr. A. E. du Pasquier (president) was in the chair. The first amendment was to Rule II, which originally read that it was necessary for a new member to be proposed by a member, seconded by another member, and to be supported by at least two other members, all from personal knowledge. Candidates wishing to join the Institute who went straight out from home, and who did not know members out there who had known them in their home capacity, were handicapped by this rule. It was agreed that the rule be altered so as to provide for such a candidate being proposed and seconded by members from personal knowledge, and the other support to be from information supplied. The next proposal was to amend Rule 20, with the object of increasing the subscription rates of country members, associates, and technical associates, but not of students. The council felt that country membership terms were too low, namely, £1 11s. 6d. and £1 1s. for a member and associate member respectively. After some opposition on the score that country members should not be taxed, the proposal was carried.

Institution of Civil Engineers of Ireland.—At a general meeting of the Institution, at Dublin last week, Mr. L. J. Kettle said there was coal underneath 1,800,000 acres of Ireland—nearly one-tenth of the surface of the whole country. The finest samples of anthracite coal he had seen were from the County Tipperary. Although anthracite coal was valuable, their consuming apparatus in Ireland had been designed for bituminous coal, for the bulk of British coal was bituminous. The exploitation of Irish coal had been handicapped by the absence of a proper mining survey; the railways of the country had apparently been built with the idea of avoiding the coalfields.

Mr. Marshall Harriss, manager of the Dublin Electric Tramways Co., agreed as to the usefulness of Irish anthracite coal. With proper appliances and furnaces, they could burn it and raise steam efficiently. Some of the owners feared that if they attempted to exploit the mineral, the Government would intervene.

Mr. S. J. Horne testified to the excellent results obtained from Irish anthracite coal in connection with suction gas producers.

Mr. J. J. Parkinson, proprietor of the Castlecomar, Co. Kilkenny, collieries, said that one of the great uses of Irish anthracite in the future would be in the form of powdered coal.

Association of Engineering and Shipbuilding Draughtsmen.—Lectures will be given at Birkenhead on January 21st; Manchester, on January 22nd; and Chesterfield, on January 23rd.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

THERE was a long debate at Blackburn Town Council, on January 8th, on a resolution to increase the salary of the electrical engineer (Mr. P. P. WHEELWRIGHT) from £800 to £1,000 a year. It was pointed out that the town had saved £15,000 by Mr. Wheelwright undertaking the personal oversight of the new super-power station at Whitebirk at a cost of over £300,000, and that having regard to the importance of his position the proposed increase was little enough. The Labour element opposed on the ground that Mr. Wheelwright was receiving far more than engineers in charge of larger works in the county, notably Stockport, Bury, and Oldham. It was also urged that the Blackburn works did not show the same favourable percentage as other works. Eventually the resolution was carried, and a motion that a further proportion of the munition profits at the electricity works should be allocated to Mr. Wheelwright was withdrawn.

Captain H. NIMMO, R.E. (T.), recently gave up his appointment as district education officer for the Woolwich district hospitals, and he left Liverpool by the s.s. *Derbyshire* on January 9th for Rangoon to rejoin the Government of Burma P.W.D. At the outbreak of war he was officiating electrical inspector to the Government of Burma, and came home at the end of 1915 to join the Forces. He was in the London Electrical Engineers R.E. (T.), until February, 1919, when he took up educational work.

Mr. C. T. ASTHURY, burgh electrical engineer of Wishaw, has resigned, having accepted a post with the Cable Accessories Co., Ltd., Tividale, Tipton, as their Scottish representative, with offices at 35, Robertson Street, Glasgow, where he takes up his new duties on January 17th.

Mr. WILLIAM STEAD, M.I.M.E., M.I.E.E., has opened an office in Manchester at Duchy Chambers, 4, Clarence Street, Albert Square, from which he will conduct his practice of consulting, mechanical, and electrical engineer. Mr. Stead's tent—by 463.135. Of the total units 43.5 per cent. were sold for private lighting; 46.5 were for power purposes; other purposes took 6.1 per cent., and public lighting absorbed 3.55 per cent. He told them at the last meeting that they

experience of power plant design and use extends over 30 years; it has included the utilisation of waste gases from blast furnaces and coke ovens, &c.

Mr. EDWIN JACOB has resigned his position as managing director of the Tudor Accumulator Co., Ltd., as from December 31st, 1919. The London office will, in future, be under the management of Mr. A. C. Soutter, who has been in the service of the company for the past 22 years. The works at Dukinfield will continue under the management of Mr. Paul Pescatore, with the same staff as hitherto.

Mr. W. A. PERRY, electrical and mechanical engineer, who has been manager of the Amoy electric light station for the last five years, has returned home after ten years' residence in the East, and is open to take up a responsible appointment.

St. Pancras Borough Council Parliamentary and General Purposes Committee, after consideration, recommends that awards No. 84 and 101 to Government employés be applied to the chief electrical engineer, whose present salary and bonus is £1,150. The increase by award 84 would be £110, and by award 101 £100, making the total £1,360.

Mr. G. F. CRAVEN, manager of the Corporation tramways at Reading, has resigned, and is succeeded by Mr. Calder. Mr. Craven has joined the board of the local engineering firm of Allen & Simmonds, Ltd.

The Batley Town Council has increased the salary of Mr. S. DERWEN JONES, electrical engineer, to £400 a year, and that of Mr. A. RUSLING, station superintendent, to £275.

Mr. J. WALKER, electrical engineer to Messrs. Bruntons, Wiremills, Musselburgh, has been appointed manager of the electrical department, Messrs Wood & Cairns, of Edinburgh, and takes up duties to-day.

Mr. J. C. ELVY, A.M.I.E.E., M.I.E.Soc., who resigned from St. Pancras to join H.M. Forces, being attached to R.A.F. Headquarters Technical Staff, was demobbed last August, and is now engaged in preparing a scheme for the electrical equipment of a large kinema studio, involving a plant of 1,000 KW. capacity.

NEW COMPANIES REGISTERED.

Electric Motors (South Wales), Ltd. (162,293).—Private company. Registered January 1st. Capital, £20,000 in £1 shares. To carry on the business indicated by the title. The first directors are: W. H. Diamond, 168, Newport Road, Cardiff, ship repairer (chairman); M. Wideman, Trewinard, 48, Victoria Road, Penarth, shipowner; T. Diamond, 5, Palace Road, Llandaff, coal merchant; E. C. R. Mackadam, 3, Plasturton Place, Cardiff, coal merchant. Qualification, £500. Registered office: 1, Wood Street, Cardiff.

Electric Repairs, Ltd. (162,566).—Private company. Registered January 8th. Capital, £1,000 in £1 shares. To carry on the business indicated by the title. The first directors are: W. Boffey, 189, Coventry Road, S. Yardley, Birmingham; W. H. Scott, 11, Bilston Road, Wolverhampton, B. F. Walter, 4, Evelyn Villas, Brook Lane, Codsall; T. Withers, jun., Hill Top, West Bromwich. Registered office: Old Bilston Road, Wednesbury.

Pourlock Co., Ltd. (162,547).—Private company. Registered January 7th. Capital, £50,000 in £1 shares. To take over the British and certain foreign patent rights relating to an invention for differential gearing, to adopt an agreement with R. A. Rothermel and C. A. Vandervell, and to carry on the business of manufacturers and repairers of and dealers in gearings, machinery, automobiles, motor cycles, &c. The subscribers (each with one share) are: T. G. Conyer, 49, Pemberton Road, Harringay, N., clerk; J. P. England, 97, Strathyre Avenue, Norbury, S.W.16, cashier. R. A. Rothermel is the first director. Solicitor: W. C. Rundle, 20, Eastcheap, E.C. Registered office: 24-6, Maddox Street, W.1.

Huffam & Son, Ltd. (162,448).—Private company. Registered January 5th. Capital, £3,000 in £1 shares. To carry on the business of engineers, manufacturers of and dealers in internal-combustion engines, steam, electrical and other motors, dynamos, motor and other cycles, &c. The permanent directors are: W. S. Huffam, 62, Mount Pleasant, Norwich; V. Huffam, Surlingham, Norfolk. Registered office: 39, Exchange Street, Norwich.

G. P. Dennis, Ltd. (162,532).—Private company. Registered January 7th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of and dealers in electrical, mechanical and general engineering supplies, &c. The subscribers (each with one share) are: G. P. Dennis, 6, Normanston Road, Birkenhead, electrical engineer; Mrs. L. Dennis, 6, Normanston Road, Birkenhead. The first directors are: G. P. Dennis (governing director) and Mrs. L. Dennis. Registered office: 66, South John Street, Liverpool.

Electro-Dynamic Construction Co., Ltd. (162,481).—Private company. Registered January 6th. Capital, £10,000 in £1 shares. To acquire the business carried on by N. Pensabene, and to carry on the business of electrical engineers, workers in metals, contractors for the supply of electrical plant, producers and distributors of electrical energy, &c. The first directors are: N. Pensabene, 4, New Cross Road, S.E. (permanent managing director), and E. J. Timberlake, 4, New Cross Road, S.E. Registered office: 4, New Cross Road, S.E.

Ebonestos Insulators, Ltd. (162,480).—Private company. Registered January 6th. Capital, £100,000 in £1 shares. To take over the business of makers of moulded "Ebonestos" insulators, turners and workers in hard woods, ebonite and fibre, &c., carried on at 127, Pomeroy Street, New Cross, S.E., and elsewhere, as the "Ebonestos Manufacturing Co.," and to enter into an agreement with J. B. Alexander and B. Weaver. The first directors are: J. B. Alexander, 62, Water Lane, Brixton, S.W.2, engineer; B. Weaver, 7, Glensdale Road, Brockley, S.E.4, manufacturer. Registered office: 127, Pomeroy Street, New Cross, S.E.14.

Steel Wire Co., Ltd. (162,320).—Private company. Registered January 1st. Capital, £700,000 in £1 shares. To carry on the business of wire drawers and bar drawers of steel, iron, copper and other metals, compounds, alloys or substances, manufacturers and owners of aerial and other ropeways, cableways and tramways, &c. The first directors are: E. Smith, The Coppice, Barrington Road, Torquay; A. Smith, 113, Westbourne Terrace, W.; Harry Smith, Manor Heath, East Morton, Bingley; Herbert Smith, Gamstone House, Gamstone, Retford; F. Smith, Pollard Hall, Gomersal; E. Smith, jun., White House, Newark. (All directors of Doncaster Wire Co., Ltd., Ordsal Wire Co., Ltd., and E. & A. Smith Co., Ltd.) Solicitors: Chadwick, Son & Nicholson, Church Street, Dewsbury.

Engineering Agency, Ltd. (162,294).—Private company. Registered January 1st. Capital, £1,000 in £1 shares. To carry on the business of an employment agency for the engineering and allied trades, &c. The first directors are: T. B. Bower, 7, Oakhill Road, Surbiton, consulting engineer; C. W. Chater, 9, Norwich Avenue, Bournemouth, consulting engineer; Florence M. Milliken, 124, Fordwych Road, West Hampstead, N.W.2. Qualification, £100. Secretary: Florence M. Milliken. Registered office: 68, Victoria Street, S.W.1.

Mica and Asbestos Insulating Co., Ltd. (162,495).—Private company. Registered January 6th. Capital, £10,000 in £1 shares. To carry on the business of manufacturers of and dealers in mica, asbestos, carta, insulating cloth, enamelled wire, &c. The subscribers (each with one share) are: Thekla Muller, 35, Fitzroy Square, W., commercial manager; Horace Barrett, 2-3, West Street, Finsbury Circus, E.C., solicitor; J. Fogg, 69, Knatchbull Road, Camberwell, S.E., clerk. Table "A" mainly applies. Solicitors: Goldberg & Barrett, 2-3, West Street, Finsbury Circus, E.C.

Holders, Ltd. (10,863).—Private company. Registered December 30th. Capital, £10,000 in £1 shares. To carry on the business of electrical, mechanical and general engineers, contractors, manufacturers and agents. The subscribers (each with one share) are: L. R. Morshead, 17 Victoria Street, London, S.W.1, engineer; R. Steel, 8, Gladstone Place, Leith, engineer. The first directors not named. Qualification, £250. Secretary: R. Mitchell. Registered office: 87, Hanover Street, Edinburgh.

Mountain Railways, Ltd. (162,384).—Private company. Registered January 2nd. Capital, £12,000 in £1 shares (6,000 preference). To obtain from the French and Italian Governments concessions for the construction and working of a railway from Briancon, in the Hautes Alpes Department of France, to Oulx, in Piedmont, in Italy, across the Mont Genevre Pass of the Alps, and to adopt an agreement with G. N. Fell. The subscribers (each with one share) are: W. Brown, 40, Woodgrange Avenue, N.12, engineer; W. R. Makepeace, 22-3, Laurence Pountney Lane, E.C.4, iron, steel, and engineering exporter. The subscribers are to appoint the first directors. Solicitors: Wilkinson, Raikes & Son, 34, Nicholas Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Dartmoor Electric Supply Co., Ltd.—Issue registered December 5, 1919, of £2,350 debentures, part of a series of £5,000 already registered.

Tyne Electric Steel Foundries, Ltd.—Particulars filed November 25th, 1919, of £15,000 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, amount of present issue being £4,400.

W. A. & R. J. Jacobs, Ltd.—Debenture for £10,000 registered November 22nd, 1919, charged on land at Edgware Road and land and buildings at Hendon and the company's undertaking and property, present and future, including uncalled capital. Holders: L.C.W. and Parr's Bank, Ltd.

CITY NOTES.

Adelaide Electric Supply Co., Ltd.

The annual meeting was held on Friday last, Mr. J. B. Braithwaite presiding. The chairman said that the most important change in the balance sheet was caused by the steps which the board had thought it prudent to take in raising the additional capital necessary to establish the future of the company. During the year they had issued £250,000 of 5 per cent. cumulative preference shares of £1 each. In view of the rates which were now being paid on similar securities he thought they were fortunate in getting those shares issued at par. They provided them with the capital which they estimated would be necessary for erecting the new power house at Port Osborne. The 5 per cent. debenture sinking fund stock continued to be redeemed, and they were offering to exchange the stock for 5 per cent. War Loan. They hoped that would enable them to obtain the amount of stock they required for the sinking fund, and would still further reduce the amount outstanding. The dividend equalisation account stood at £25,000, the same as for some years past, and was a sort of guarantee that the dividend was likely to be maintained at the figure at which it had stood for some years. The results of the past year had been disastrously interfered with by the prolonged strike in Australia, which only just ended about the close of their financial year. The strike cost the company very considerable sums directly and indirectly. They lost 2¼ millions of units in output, and in the net result, the profit instead of being, as they had every reason to expect it would have been from the results of the first seven or eight months of the year absolutely a record for the undertaking, was nothing very striking. As it was, the revenue had increased by £18,993 which in the circumstances was very satisfactory. The increase in consumers connected was very satisfactory, but it would have been larger but for the seamen's strike, which delayed the shipment of poles, so that they were unable to make the necessary connections. It was a very satisfactory thing that the expenditure they had made in the past on extending their mains into districts where they were likely to get new consumers, was now bearing fruit, as was evidenced by the fact that of the new consumers connected last year no less than 832 were made with no extensions of the mains at all; it was a thickening up of the mains they had already laid. In spite of the strike, not only did the gross revenue increase a little, but the units sold increased to a small ex-

had established a night tariff with a view to inducing people to take current during the night, when the load was not wanted for other purposes. The number of consumers who had availed themselves of that night supply had increased from 65 to 95, and they were still continuing to receive inquiries. With regard to the new power house at Port Osborne, a lease had been secured on satisfactory terms, and they were now actively engaged in the laying out of the station. In view of the labour troubles he did not like to say when they hoped to have the power house running, but the board would press on with the matter with the utmost possible speed, so that they might reap the advantages they expected at the earliest possible date. The record of the company's employés in regard to the war was: 91 enlisted, of whom seven were killed, and 34 had already returned to the company's employ. They continued to give preference in employment to returning soldiers, whether they were previously in their employ or not, and out of a total establishment of 323 male and female employés, 62, or 19.2 per cent., were returned soldiers.

Mr. R. Percy Sellon seconded the motion.

German Companies.

The E. H. Geist Elektrizitats A.G., of Cologne-Zollstock, which was compelled to go into liquidation several years ago in consequence of the competition of the big firms even for comparatively small contracts, has now held its final meeting, and will be removed from the register.

The report of the *Norddeutsche Kabelwerke A.G., of Berlin-Neukoln*, states that it was impossible for sale prices to keep pace with the growth in the working expenses in 1918-19. After placing 15,000 marks to depreciation, as compared with 260,000 marks in the previous year, the accounts indicate net profits of 400,000 marks, as against 378,000 marks, permitting of the payment of a dividend of 14 per cent., as contrasted with 15 per cent. in 1917-18. The share capital is now to be increased from 3,000,000 to 5,500,000 marks.

The A.G. fur Elektrizitats Anlagen, of Berlin, which is chiefly an investment company, states in the report for 1918-19 that two of the company's works are situated in Poland, one in the free State of Dantsic, and one in the occupied district of the Saar. The future of these works was uncertain, and the liquidation of the interests held in the Imatra Co., of Brussels, and the Moscow Electric Power Transmission Co., of Petrograd, could also not be foreseen. The net profits amount to 533,000 marks, as against 630,000 marks in 1917-18, and the dividend is at the rate of 5 per cent., this contrasting with 6 per cent. in the preceding year.

The directors of the *Rheinische Elektrizitats A.G., of Mannheim*, which owns and contracts for the erection of supply works and installations, state in their report for 1918-19 that the company had been compelled to purchase large stocks of raw materials owing to the great activity in new construction and installation work, the high prices paid absorbing a considerable sum. It was therefore proposed to issue 4½ per cent. debentures for 5,000,000 marks, and to increase the share capital from 11,000,000 to 16,000,000 marks. The accounts show net profits of 1,000,000 marks, as against 1,001,000 marks in 1917-18, and the dividend is 7 per cent. and 5 per cent. in the two years respectively.

The report of the *Siemens-Schuckert Werke, of Berlin*, for 1918-19 states that the company was confronted with difficult problems owing to the oppressive burdens of the Treaty of Peace and the taxation policy of the "Empire." The great requirements of the world could afford the company an abundance of work; it must be remuneratively fashioned in the interest of German industry. The unfavourable situation of German currency should not lead to the dumping of national manufactures. A recovery of the national economy could only be brought about by a material increase in the production, which was not attainable with the present average output per workman, and by the greatest economy at home, and an expert financial policy. Including the balance brought forward the gross profits are returned at 28,488,000 marks, as compared with 26,940,000 marks in 1917-18, and the net profits at 15,293,000 marks and 15,837,000 marks in the two years respectively. The dividend is at the rate of 10 per cent., being the same as in 1917-18.

Anglo-American Telegraph Co., Ltd.—Balance dividends of £1 10s. per cent. upon ordinary consolidated and preferred stocks, and a first and final dividend of £1 10s. per cent. upon the deferred stock, less tax, in each case, making, with dividends already paid, £3 15s. per cent. upon ordinary consolidated stock, £6 per cent. on preferred stock, and £1 10s. per cent. on deferred stock for 1919.

Dublin United Tramways Co. (1896), Ltd.—After paying 7 per cent. final on the ordinary shares, making 6 per cent., plus a bonus of 1s. 6d., tax free, for the year, £17,080 is carried forward. To track renewals £30,000 is put; £27,000 to car renewals; £12,821 to general reserve; and £4,000 to depreciation of investments.

Kaministiquia Power Co.—Dividend on the common stock for the quarter ending January 31st at the rate of 8 per cent. per annum.

Montreal Light, Heat & Power Consolidated Co.—Quarterly dividend of 1 per cent., less tax.

STOCKS AND SHARES.

TUESDAY EVENING.

WHILE in some departments of the Stock Exchange business has quieted down to a slight extent, on the whole there is still a lot of trade doing. The disappointment felt at the failure of negotiations in the moulders' strike has not sufficed to hold back prices of iron, steel and engineering shares, but the possibility of imminent railway trouble makes itself felt in the Home Railway market, where prices have yielded ground again. Speculative investment continues active. The view is generally expressed round the Stock Exchange, however, that if the railwaymen should strike, and particularly if they do so without warning, the effect upon markets would be much the same as it was last autumn, when for a few days a sort of semi-paralysis settled over enterprise, forcing down the prices of speculative issues, while at the same time it produced a demand for the more sober stocks. The anomaly in the coal trade, whereby manufacturing concerns, having to pay more for their coal than the ordinary householder, are enabled to obtain supplies fairly freely, removes the apprehension of acute coal shortage from the industrial departments, and the electricity supply section, amongst others, has hardened up.

Statements which were current to the effect that the General Electric Co. and Edison Swan were going to amalgamate have been promptly denied, and the course of Edisons has been rather curious. The shares, after being 27s., fell to 24s. 9d., from which latter figure there was a brisk recovery to 26s. 3d., and the market looks a good one, with several substantial buyers about. Expectation is kept alive by mysterious hints as to developments which are likely to occur, and it is said that next week should bring definite news. In the meantime, it would appear to be advisable for proprietors to keep their shares.

Another rumour which was current some time ago, and which was contradicted at the time, seems likely to prove material after all. As we mentioned here, the Anglo-Argentine Tramways Co. was expected to pay off the arrears of interest which have accumulated on the first and second preference. Like the report of Mark Twain's death, this turned out to be premature. Newa, however, has come in this week that the municipality of Buenos Aires has sanctioned the ordinance approving a 12-cent fare. This is exactly what the company had been hoping, and should make such a difference to the receipts of the undertaking as may easily enable the arrears of dividends to be paid. Prices of the company's issues are therefore harder. The last time that the first preference received a dividend was in June, 1917, while the second preference have gone without anything since January, 1916, so that there is 2¼ years, equivalent to 13s. 9d., less tax, due on the former class and £1 3s. on the second. It looks, moreover, as though the company were likely to regain its earning capacity, and the announcement is very gratifying to those who have maintained their faith in the concern during the war period.

Underground Electric income bonds have dropped back 5¼ to 84. The ordinary shares shed ¼ to 21, and the "A" went back to 7s. 6d., while Districts and Metropolitans are both lower at 21 and 25 respectively. Congestion on the lines meanwhile becomes, if possible, more acute. Between the company's intention to raise fares and the furious protests which have arisen against such a step on the part of the uncomfortably-carried travellers, the investor has little inducement for buying Undergrounds, and the present holder is somewhat in despair at the whole position. Nevertheless, the income bonds may be cautiously recommended as worth mixing with other investments owing to the return which they offer, the fact that the dividend is paid free of tax and also that the coupons can be cashed in New York at the fixed rate of 4.86 dollars to the £. As soon as the present tyranny of uncertainty is over-passed, the price might easily go to the neighbourhood of 90, though it has to be remembered that more capital is likely to be wanted before long, and that anything of this sort may rank in front of these income bonds.

The feature amongst electricity supply shares is the strength of Citys, a rise of £1 carrying the price to 13. This is fully 30s. higher than it was at the time when attention was first drawn here to the likelihood of the company increasing its dividend in respect of the last six months. Metropolitans are ¼ up at 3¼. It is reported in the market that there is rather more inquiry for shares in this group, although it must be admitted that popular attention is still meagre. General Electrics are better at 41s. British Insulated at 2 1-16 are the fraction to the good. India-Rubber shares fell away abruptly to 16, which is ex the dividend. Siemens lost 1s. of their previous half-a-crown rise. Castner-Kellners have further added 8s. 9d. to their price on the proposed arrangement with Brunner Monds, whereby the latter company offers two of its own shares to every one of Castner-Kellner. Brunner Monds stand about 41s. 3d. Several other possible amalgamations are talked of in this department, and all the tendency nowadays is in the direction of big combinations. In which connection it may be incidentally observed that a broker asking the price of some unfamiliar share the other day was told that it was not known in the market, the company being "a small affair, with a capital of only a quarter-of-million sterling."

The cable market is uninteresting. Anglo-American deferred rose ¼ on the declaration of the dividend, which is 30s. for the year. United River Plate Telephones have recovered to 7¾. Marconis are a better market at 4 5-16. Gossip once more plays with a report, said to emanate from the other side of the Atlantic, that there may be coming fusions in this group before very long. Possibly this accounts for the recent buying of Canadian Marconis, which has stiffened the price to 14s. 3d. American Marconis remain a quiet market at 33s. Callenders at 8¾ have started to recover after their recent heaviness, and the preference are better at 4¾. Automatic Telephones have risen to 35s. bid.

Mexicans have gone ahead in fine style. Practically everything connected with the country advanced by leaps and bounds. The advent of a Commissioner to this country from Mexico is held as a precursor to the ardently-desired settlement which has been tantalisingly within reach for the last year or two. Carranza is declared to be heartily sick of chaos, and to be anxious to consummate a loan with the United States that shall re-establish his distressful country. Consequently, rises ranging from 2 to 10 points have occurred in various issues of the Mexican government, railway and utility companies. There has not been much actual business, quotations being marked up largely as a matter of sentiment. This accounts for the lack of discrimination which has occurred in adding points to prices, various anomalies being noticeable in the way in which common and preferred shares have been lifted to nearly the same levels as the bonds. Best prices were not maintained, but any confirmation of the more favourable atmosphere (which is all it can be called at present) would probably advance prices still further. In Engineering shares, Babcock & Wilcox are ½ harder. Rubber shares keep tolerably active, although a setback in the price of the raw material laid a check upon the previous optimism.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Jan. 13, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	8⅞	—	£6 16 2
Charing Cross Ordinary	4	4	3	—	6 13 4
do. do. do 4½ Pref.	4½	4½	2⅞	— ¼	8 8 8
Chelsea	5	8	2⅝xd	—	5 14 3
City of London	8	8	13	+ ⅜	6 3 1
do. do. 6 per cent. Pref.	6	6	9¼	—	6 6 4
County of London	7	7	9¾	—	7 9 4
do do. 6 per cent. Pref.	6	6	9¼	—	6 11 3
Kensington Ordinary	7	6	4¾	—	6 6 4
London Electric	Nil	Nil	1¾	—	
do. do. 6 per cent. Pref.	5	6	8⅝	—	8 17 10
Metropolitan	4	5	8¼	+ ¼	8 0 0
do. 4½ per cent. Pref.	4½	4½	2½xd	—	7 16 6
St. James' and Pall Mall	9	10	6	—	8 6 8
South London	5	5	2½	—	7 8 6
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5½	—	7 12 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	90½	—	6 12 8
do. Def.	1½	83/8	22⅜	+ ¼	6 14 1
Chile Telephone	8	8	6⅜	—	6 5 6
Cuba Sub. Ord.	7	7	10½	—	*6 18 4
Eastern Extension	8	8	18	—	*5 0 0
Eastern Tel. Ord.	8	8	167½	—	*4 15 7
Globe Tel. and T. Ord.	7	8	16¼	—	*4 19 3
do. do. Pref.	6	6	9⅞	—	6 3 1
Great Northern Tel.	22	22	23½	—	9 7 2
Indo-European	13	13	48½	—	6 13 4
Marconi	20	25	4 5/16	+ 1/16	5 16 8
Oriental Telephone Ord.	15	10	2⅜	— 1/16	4 14 1
United R. Plate Tel.	8	8	7¾	+ 1/16	*5 3 3
West India and Panama	1/3	1/3	1 1/16	— 1/16	Nil
Western Telegraph	8	8	17	—	*4 14 2
HOME RAILS.					
Central London Ord. Assented	4	4	58½	—	6 16 9
Metropolitan	1	1½	25	— 1	5 0 0
do. District	Nil	Nil	21	— ½	Nil
nderground Electric Ordinary	Nil	Nil	2¾	— ¼	Nil
do. do. "A"	Nil	Nil	7/6	—3d	Nil
do. do. Income	4	5	84	—3½	*5 19 3
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	3⅞	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	4	+ ½	—
do. do. 2nd Pref.	—	—	3⅜	+ ¼	—
do. do. 5 Deb.	5	5	64½	+3	7 15 0
Brazil Tractions	—	—	60	—1	—
Bombay Electric Pref.	6	6	13½	—	4 9 0
British Columbia Elec. Rly. Pfce.	5	5	62½	—	8 0 0
do. do. Preferrred	Nil	2½	56½	—	4 8 9
do. do. Deferred	Nil	Nil	52½	—	Nil
do. do. Deb.	4½	4½	63	+ ½	6 15 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	46	+3½	Nil
do. 6 per cent. Bonds	Nil	Nil	86½	+7½	Nil
Mexican Light Common	Nil	Nil	22½	+5	Nil
do. Pref.	Nil	Nil	35	+5	Nil
do. 1st Bonds	Nil	Nil	58	+4½	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3⅜	+ ½	*4 9 0
British Aluminium Ord.	10	10	1 3/16	—	5 12 3
British Insulated Ord.	25	12½	2 1/16	+ 1/16	6 1 6
Callenders	25	25	8⅝	+ ⅛	7 5 0
,, 6½ Pref.	5	6½	4⅞	—	7 2 1
Castner Kellner	25	20	3⅛	+ 1/16	3 15 7
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	10	1 1/16	+ ⅛	7 12 4
do. do. 5 per cent. Deb.	4	5	79¼	—	6 5 9
Electric Construction	10	10	1 1/16	—	9 8 2
Gen. Elec. Pref.	6	6½	19/6xd	—	6 12 6
do. Ord.	10	10	41/-	+1/-	*4 17 7
Henley	25	25	2½	—	5 11 1
do. 4½ Pref.	4½	4½	3⅜	—	6 4 9
India-Rubber	10	10	16	—1½	*6 5 0
Met.-Vickers Pref.	—	—	2 1/8	—	5 14 0
Siemens Ord.	—	10	28/6	—1/-	*7 0 4
Telegraph Con.	20	20	26½	—	*4 10 6

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, January 13th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£95	...
a Ammonia, Muriate (large crystal)	,,	£75	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£39	...
a Copper Sulphate	,,	£44	£3 inc.
a Potash, Chlorate	per lb.	1/1	...
a ,, Perchlorate	,,	1/3	...
a Shellac	per cwt.	£43 10/-	£10 10/- in.
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£35	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	170/-	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/3½	½d. inc.
c ,, Tubes (solid drawn)	,,	1/7 to 1/7½	½d. to 1d. inc.
c ,, Wire, basis	,,	1/4	1d. in.
c Copper Tubes (solid drawn)	,,	1/9½	1½d. in.
g ,, Bars (best selected)	per ton	£167	£10 inc.
g ,, Sheet	,,	£167	£10 inc.
g ,, Rod	,,	£167	£10 inc.
d ,, (Electrolytic) Bars	,,	£125	£3 dec.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£140	£3 dec.
d ,, ,, H.C. Wire	per lb.	1/5½	½d. dec.
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	2/9	4d. inc.
h Gutta-percha, fine	,,	13/-	2/- to 3/- inc.
h India-rubber, Para fine	,,	2/7½	¾d. inc.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£48 10/-	£4 10/- inc.
g Lead, English Pig	,,	£48 10/-	£2 inc.
g Mercury	per bot.	£23 10/-	10/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/8 to 2/-	1½d. to 2d. inc.
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11	½d. inc.
r Steel, Magnet, in bars	per ton	...	...
g Tin, Block (English)	,,	£378	£38 inc.
n ,, Wire, Nos. 1 to 16	per lb.	5/-	6d. inc.
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e P. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Two American Turbine Accidents.—A 3,000-KW. horizontal Curtis turbine, installed in the station of the Connecticut Light and Power Co., Waterbury, Conn., eight years ago, completely wrecked itself on November 18th, killing two men, injuring others, and doing damage to other turbines and the power-house building. The machine ran at 1,800 R.P.M., and had a rim speed of about 400 ft. per second, which is much lower than velocities which are safely carried upon modern machines by the same builders. Some of the wheels were split apart, others were badly battered and broken at their peripheries; the shaft was broken, and the bolts in the coupling were bent. The turbine end of the shaft was hurled upward, just clearing the adjacent turbine, but bending the lifting bolts in the top of its casing; the broken shaft continued on, striking and bending the crane rail and landing outside the turbine-room. Exclusive of the generator stator and rotor, the heaviest piece of broken metal probably did not weigh more than 500 lb. Viewing the wreck and the turbine-room, it seems remarkable that the severe damage was confined to one machine. This turbine was one of six, all set transverse of the room, having two machines to the north and three to the south of it.

News comes also of the failure of a 4,000-KW., six-stage, 1,800-R.P.M. unit at the Ashley Street station of the Union Electric Light and Power Co., at St. Louis. This was installed in 1911, and was the second of the horizontal type put out. Investigations of both accidents are under way.—*Power.*

Sparking at Brushes. — Although sparking at the brushes of low-speed machines may not cause serious trouble, it is as well to take steps to prevent it. The peripheral speed of the commutators is insufficient to throw off dust particles and cleaning at intervals is a troublesome operation. A suggestion, put forward by Mr. B. A. Briggs in *Power*, for the prevention of sparking is that an additional brush be mounted in a separate holder. This brush can be made of wood or fibre, the actual part in contact with the commutator consisting of two or three pieces of canvas cut to the necessary width. The canvas can be turned or changed when necessary, the frequency depending upon the nature of the surrounding atmosphere.

THE PHYSICAL SOCIETY'S EXHIBITION.

THE tenth annual exhibition of electrical, optical and other physical apparatus held under the auspices of the PHYSICAL SOCIETY OF LONDON and the OPTICAL SOCIETY at the Imperial College of Science and Technology, South Kensington, on January 7th and 8th, was looked forward to with more than usual interest, it being the first post-war exhibition, and was hoped to reveal the progress that had been made during the war period by scientific instrument manufacturers. Although there was a good deal of interest to be seen, we were disappointed to find on the occasions of our visits that the attendance was very small.

The discourses by Prof. F. J. CHESHIRE, C.B.E., on "Some Polarisation Experiments," and by Prof. A. O. RANKINE, D.Sc., on the "Use of Light in the Transmission and Reproduction of Speech," were full of interest. The latter explained that the main effect of light upon the element selenium was due to the red rays of the spectrum. Its susceptibility to red rays was illustrated by a magnified beam passed through red-coloured glass and thrown on a scale by a mirror galvanometer; the maximum effect lay somewhere between the orange and the red. Prof. Rankine then explained his photophone, which consists essentially of a gramophone sound-box with a delicately poised mirror in place of the needle. The mirror oscillates in accordance with the fluctuations of the sound, and the beam from the mirror, travelling to the receiver, conveys these oscillations with it, the sound being reproduced in a telephone with the aid of a selenium cell. With sunlight there would be practically no limit to the range of transmitting speech through the medium of light other than that interposed by the curvature of the earth. With a helio mirror of 6 in. diameter, however, distinct hearing was possible at a distance of eight miles. There was an important advantage in this over wireless telegraphy in the fact that speech transmission between the transmitter and the receiver could not possibly be intercepted. The two instruments had to be in line with the beam. Photographs of speech recorded by the selenium apparatus were shown, including the vibrations produced by articulating the words "one" and "five." The open vowel sound of the latter was brought out conspicuously.

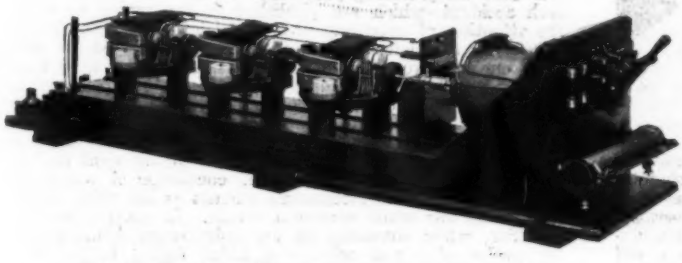


FIG. 1.—EVERSHED HIGH-PRESSURE D.C. SET, WITH COVER REMOVED.

One of Prof. Rankine's conclusions is that the average individual makes more vibrations than his auditor requires, but the ear makes up for many deficiencies.

The collection of WAR EXHIBITS included a number of interesting captured German instruments relating to artillery and gun sighting. German compasses were exhibited by the ADMIRALTY COMPASS OBSERVATORY, Slough, while the AIR MINISTRY had on view a collection of captured German instruments, amongst which the following were noted: A type A.F.S. 43B. Telefunken sender; type E. Vi 89C. amplifier in a case with valves, resistance tubes, voltmeter, H.T. battery in case, and suspension springs; a W/T type D. No. 1,115 transmitter from a D.F.W. two-seater; a Huth short-wave receiver complete in case; a 270C. Telefunken generator; a Grass & Worff signalling lamp and Bosch landing light; an Accumulator-Fabrik A.G. "Varta," 12-volt, 26 amp.-hour unspillable accumulator; a wind-driven, 200-watt, 50-volt, D.C. Telefunken generator; a Sachsenwerk 250-watt, 50-volt, D.C. gear-driven generator; and an electrically-heated muff and boot.

The "SHERINGHAM DAYLIGHT," which we described in a recent issue, was experimentally demonstrated at intervals by Mr. L. C. MARTIN. This invention is a reflector for correcting artificial light, the result, it is claimed, closely approximating daylight. An attempt is made to reduce the excess of rays in the red end of the spectrum present in artificial light and thereby to emphasise the effects of the blue and violet rays.

MESSRS. NEWTON & CO. showed optical lanterns and fittings for use in lecture halls, &c., including a hand-feed arc lamp for optical projection work, and a new half-watt metal-filament lamp with resistance for any supply from 100 to 240 volts. Another new half-watt lamp was shown with an accumulator and a special mirror for use in optical lanterns. This lamp, being provided with a special cone form of concentrated filament, is claimed to give very good results for small halls where electricity supply is not available. It is made in two patterns for use with 6 or 12-volt batteries, consuming 5 amps. in each case.

MESSRS. EVERSHED & VIGNOLES, LTD.—Standard "Megger" and "Bridge Megger" resistance testing sets, the "Dionic" water tester, portable indicating instruments, and recording instruments formed the basis of this exhibit. "Workshop" ohmmeters were shown, which without the use of a bridge rapidly give not only insulation resistances but also other resistances by direct reading, and can be supplied to cover a range from 10 microhms to thousands of megohms. An improved form of D.C. leakage indicator, which not only gives warning of the development of a fault but also enables the insulation resistance of each main to be measured, was exhibited in operation; the chief difference from the earlier pattern is the use of a switch instead of pressing keys to obtain the successive readings. An accompanying table at once gives the insulation resistance of each main from these readings.

FIG. 2.—EVERSHED LEAKAGE INDICATOR.

The most striking feature of the exhibit was a high-pressure D.C. motor-generating set, giving 15 milliamperes at any voltage up to 5,000 volts; the set consisted of a motor driving three small magneto-generators, which were connected in series and mounted on a base-board with suitable insulators. A specially designed cut-out protects the machine from damage due to overload or a sudden short-circuit. The generators are so constructed that the pressure wave-form is practically free from ripples, and the current generated is suitable for X-ray, cathode-ray, and research work generally.

MESSRS. ELLIOTT BROTHERS (LONDON), LTD., had a handsome show of their standard apparatus, including a laboratory wattmeter with a variety of ranges, millivoltmeters, a portable bridge, the "Century" testing set, and their tubular magneto and revolution indicator, which is used to indicate at a distance the speed of the engines of aircraft. Other items were parts of the Elliott gyrostat, and a variety of etched metal name plates, dials, &c., a branch of work in which the firm has attained to a high degree of accuracy and excellence of workmanship.

MESSRS. CHANCE BROTHERS & CO., LTD.—Protective glasses for use in connection with the arc and in the presence of ultra-violet rays and X-rays were a special feature of this exhibit; a nickel-chromium arc was used as a source of ultra-violet rays, and demonstrations were given of the fluorescence of uranium glass and light barium flint glass. It was shown that when the visible rays of the arc were completely cut off by a thick screen of apparently opaque black glass, the ultra-violet rays were transmitted almost unaffected, but in turn were stopped by the interposition of a thin glass plate which was as transparent as window glass. Sir William Crookes's spectacle glasses "A" and "B," which are manufactured by the firm, were exhibited; their opacity to ultra-violet rays depends upon the use of cerium and didymium in their composition, and they can be made practically as white as ordinary spectacle glasses. By the use of screens opaque to visible rays but transparent to

ultra-violet rays, with the aid of a sighting device, our merchant ships were able to keep station in convoys whilst no visible light was emitted to betray their positions to enemy submarines.

MESSRS. A. C. COSSOR, LTD., exhibited a representative collection of the latest models of X-ray tubes, applicators for electro-medical treatment, wireless valves, and other manufactures, which are of entirely British manufacture and of which a large number was supplied to the War Office. The X-ray tubes on view included the water-

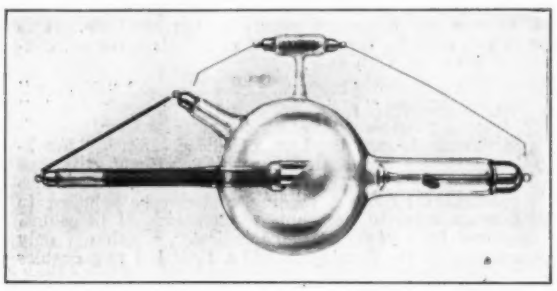


FIG. 3.—COSSOR IRIDIUM-TARGET X-RAY TUBE.

cooled and heavy-discharge radiator types of both iridium and tungsten target tubes, the latter target having, it is claimed, a very long life. Fig. 3 shows a pure iridium target tube with a bulb diameter of 20 cm. Heavy-anode and special-treatment tubes were included in the exhibit, each of the latter being guaranteed to have, before issue, turned a Sabouraud

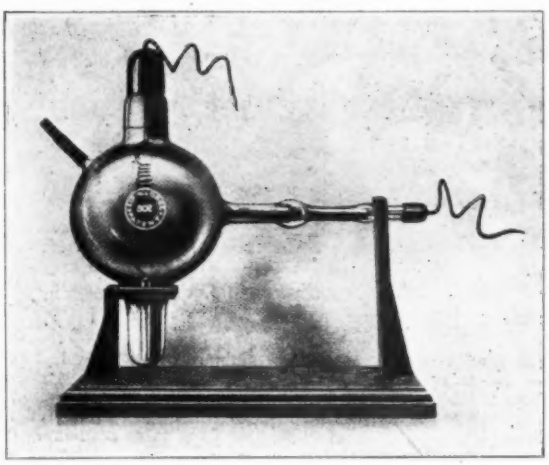


FIG. 4.—LODGE HIGH-TENSION VALVE.

pastille, placed 7.5 cm. from the target, to the standard tint in 10 minutes when using one milliampere. Sir Oliver Lodge's high-tension valves for heavy discharges, which require practically no regulation, were also shown. This type of valve, fig. 4, is noted for long life, high efficiency, and heavy current-carrying capacity.

MARCONI-OSRAM VALVE CO., LTD.—This interesting exhibit was almost entirely of an historical nature, illustrating the evolution of the thermionic valve, from the rectifying valve of Dr. Fleming in 1904 to the most recent three-electrode types made by the company, which supplied them in large quantities to the Government during the war. The first valve manufactured in quantity was the "T.1" (150-200-watt transmitting), made for the Navy in May, 1917, by the Osram-Robertson Lamp Works; the first high-vacuum power valve (T.3, 350-watt transmitting) was made by the same company in February, 1917. During the same year several other valves were developed, for receiving, amplifying, rectifying and transmitting, and improved types followed one another in quick succession. Twelve of the exhibits date only from 1919, and amongst these are found many large valves, including a 1-KW. rectifying valve developed in March last by the Marconi-Osram Valve Co., and a 500-watt transmitting valve developed in September by the Osram-Robertson Lamp Works for commercial use. With the Marconi MT.1 valve (250-watt) wireless telephonic communication has been accomplished across the Atlantic. During the war the products of the Osram works were of the utmost value to our fighting forces, and it would be difficult to assign a limit to the possibilities of the thermionic valve in its peace-time applications.

(To be continued.)

ELECTRICITY IN BRITISH MINES.

THE section of the annual report of the Chief Inspector of Mines for 1918 dealing with labour, which has just been issued as a White paper* contains some interesting details regarding the use of electricity in mines. According to the Coal Mines Act a return has to be made on January 21st of each year of the aggregate horse-power of electric motors in use above and below ground at each coal mine, and the following summary shows the position at that date in 1919:—

	Surface. H.P.	Underground. H.P.	Total. H.P.
Scotland	40,330	143,869	184,199
Northern	112,375	114,949	227,324
York and N. Midland	98,451	82,049	180,500
Lancs., N. Wales and Ireland...	20,989	31,109	52,098
South Wales	125,770	124,286	250,056
Midland and Southern	18,860	52,330	71,190
	416,775	548,592	965,367

Comparing these three totals with the previous year, an all-round increase is shown, though the percentages are not high, being 6.39 in the case of surface motors and 5.12 for underground. The percentage increase of H.P. above and below ground together amounting to 5.66, was lower at January, 1919, than in any year since (and including) 1912, when the figures were first available. This is particularly reflected in the small increase in the number of electrically-driven coal cutting machines in use. These numbered 1,797 at the end of 1918, an increase of only 58, or 3.3 per cent. over the previous year. The slow rate of growth in 1918 was, of course, primarily due to other and more urgent demands upon the engineering works of the country.

During the year 1918 there were altogether seven fatal accidents at mines definitely due to electricity, resulting in one death in each case. Only one of these accidents took place above ground, and the figure for electric-shock accidents below ground (viz., 6) shows a disappointing increase of four over the preceding year. Consideration of the details of each accident—which are published in the report to direct the attention of managers and electricians-in-charge (among others) to the defects of plant or organisation—shows that with one or two possible exceptions, all might have been avoided by attention to simple and well-established safeguards. In two cases, for example, conduits or cables were used by men to help themselves along on particular occasions, causing an undue strain which snapped the cables, while in the case of the surface accident a surface boiler stoker took hold of a broken overhead lighting wire, consisting of one-strand 16 S.W.G., carrying alternating current at 230 volts, which was in his way while moving a wagon. In another instance a collier, while signalling on an underground haulage road by means of a pull wire, was killed owing to the wire coming in contact with an armoured cable on which the insulation had become defective. Three-phase alternating current, 400 volts, was in use.

Turning from coal mines to metalliferous mines, the following table shows the aggregate horse-power in use above and below ground in the latter at the end of 1918:—

	Surface. H.P.	Underground. H.P.	Total H.P.
Scotland	629	329	958
Northern	603	3,373	3,976
York and Midlands	194	284	478
Lancs., N. Wales and Ireland	2,775	3,246	6,021
South Wales	348	113	461
Midland and Southern	5,714	1,537	7,251
	10,263	8,882	19,145

American Plans in British India.—There are rumours of the probable early appointment of a permanent Trade Commissioner in India by the United States Government, although so far the American Consulate in Calcutta is without definite news on the subject. In this connection, however, it is of interest to observe that Mr. W. H. Rastall is now visiting India as a Special Trade Commissioner of the United States Government to investigate the prospects for the extension of the sale of American machinery. Mr. Rastall is a mechanical engineer, who during the war was in charge, in Washington, of the aircraft productions of two of the American States, and he was dispatched on this special mission to the East just before the Armistice was signed. He came to India *viâ* Java and the Straits Settlements, and proposes to stay four months, then proceeding to China and the Far East. Up to the present, with the exception of the American Consular officers in Calcutta and Bombay, virtually no commercial work has been conducted on behalf of the United States Government in India, but this mission and the probability of the appointment of a permanent Trade Commissioner would seem to indicate a determination to foster trade officially, and to presage still keener American competition in the Indian markets.—*Board of Trade Journal.*

* Mines and Quarries: General Report, with Statistics, for 1918. Part II—Labour (Cmd. 490). Price 6d. from H.M. Stationery Office.

FAILURES OF TURBO-GENERATORS, AND SUGGESTIONS FOR IMPROVEMENTS.

By J. SHEPHERD, M.I.E.E.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

AFTER several years of experience in many stations and with different designs of machines, the more usual types of failures have been determined and may be roughly classified under :—

(1) Mechanical weakness,
(2) Electrical weakness,
(3) Heating and fire risk,
(4) Ventilation difficulties.

MECHANICAL WEAKNESSES.

The efficiency of the steam turbine increases materially with its speed, and modern generators are now run at speeds which would not have been considered practical six years ago. The centrifugal stresses in the rotor teeth, upon the rotor coils and their insulation are serious in amount, particularly so with speeds of 3,000 R.P.M., the centrifugal forces increasing with the square of the speed.

To limit these stresses and retain the maximum speed of rotation, the diameter of the rotor is reduced to the smallest practical dimension, the increase in size for increasing output being more in length than in diameter. As a result, the running speed of the generator is generally above its first "critical" speed.

One serious result of the high speeds of rotation is the difficulty of effectively holding the rotor coils against centrifugal forces. The portion of the coils within the winding slots is retained in place by metal wedges driven into dovetailed recesses, machined out of the top of the rotor teeth. The portions of the windings forming loops at each end of the rotor cannot be held in this manner. Originally they were secured in place by steel wire bands wound tightly upon the completed coils.

Such steel bands are, however, open to grave objections. When a short-circuit occurs at the ends of either the rotor or the stator, the bands are usually fused and the steel wires rapidly unwind. Again, the ends of the wire banding may become unanchored. Whenever a wire band fails, the result is invariably the wreckage of the rotor and stator windings, with more or less serious destruction of the ends of the stator core.

Consequent upon these troubles, solid rings of high-tensile steel are now used instead. These rings are turned out of substantial forgings in which internally hidden flaws may exist, and, from the standpoint of reliable mechanical strength alone, they have not the advantage of drawn-wire bands. Moreover, alloys like nickel and chrome steel are comparatively new, and the effect on them of prolonged heat and continued stress has yet to be determined. If during ageing, a slow and continuous reduction in elastic tensile strength occurs, a periodic renewal of the bands will be necessary. The failure of a band is a catastrophe to be avoided at all costs, for it generally results in serious loss of life and plant.

For many years a flexible type of coupling between the rotor of the alternator and turbine was generally used. Such flexible couplings required two bearings each for the turbine and generator. As the size of the combination increased, mechanical difficulties were experienced. Some 12 years ago, Continental makers began to discard flexible couplings, and that practice has now been followed in this country.

The internal losses of a modern generator are about 4 to 5 per cent. of the rated output, and the heat resulting from these losses is almost invariably dissipated by forced air ventilation through specially constructed air vents in the rotor and stator. With higher speeds, smaller diameters, and increased length of rotors, it becomes a matter of great difficulty to pass the required amount of cooling air through the rotors. Generally there is adequate room in the stator for the air ventilating-spaces at the expense of iron space. On modern machines, the volume of the stator taken up by ventilating spaces is from 15 to 25 per cent. of the total volume.

This method of open construction gives a mechanically weak form of stator core and, under the alternating stress, chattering of the teeth may occur with consequent breakage. A further mechanical weakness occurs at the end of the stator where the winding must have spacings for the air freely to pass between them.

Another mechanical defect in the stator is the method of attaching the stampings to the frame. In earlier designs of generators, each stamping had two (or more) dovetailed keys on each sector, and these keys were threaded into machined keyways cut in the cast-iron frame. The cheaper form of construction afterwards adopted on the Continent was to stamp the dovetailed keyways in the sectors with corresponding keys let into the frame. This construction does not give so direct a connection to the frame as the former, and has been the cause of numerous failures. With faulty workmanship and inadequate proportion of the keys, the core worked slack at the keyways, with complete failure of the stator after a few months' working. In other cases the volume of iron has been insufficient, and the induction in the iron near the keys has caused serious overheating of the stampings and reconstruction of the stators became necessary. The probable cause was the formation of eddy currents in the steel keys, with the overheating of the keys and the portions of the disks near them. With certain conditions of load, this overheating became so serious as to burn off the paper insulation on the disks and to throw out a shower of sparks from the burnt paper at the air discharge. The former construction having dovetailed keyways punched out of the stampings gives a sounder machine. At the same time the later method may give a good machine provided the keyways are well punched, of adequate size, and that proper allowance is made for the active metal lost by punching the keyways out of the sectors.

Inaccurate punching of the plates is another source of trouble, entailing excessive filing of the stampings after building; and to prevent serious eddy currents across the burrs caused by the filing, the plates are more lightly packed together than is desirable, and vibration takes place.

Owing to the limitation of railway facilities the stators of large generators must be built on site under usually somewhat primitive conditions. Consequently the preparation of the stampings and their building up is not always so carefully carried out as when erection takes place in the shops.

ELECTRICAL WEAKNESSES.

The electrical weaknesses in turbo-alternators have generally developed since the size of the machines and the systems to which they were connected increased to over 30,000 KW. on a single set of busbars. The insulation on the stator bars is almost invariably micanite, worked on hot with a Haefley wrapping. If the stator bars are not adequately supported, bending will occur and cracking of the micanite insulation will result usually just inside the ends of the stator core. A number of different types of insulation have been introduced using Empire tape and similar fabric, interleaved with mica. After use at the ordinary working temperature of turbo-alternators the fabric loses its flexible character and becomes as brittle as mica.

The joint between the bars and the end connectors is generally soldered, and if care and time be taken a sound joint can be made by experienced workmen. There is, however, always the difficulty that out of hundreds of joints in a machine one may be defective. In practice it usually happens that a faulty joint is only detected through the machine giving way and the solder melting, with every risk of a fire.

The greatest electrical weakness in turbo-generators constructed a few years ago was their inability to withstand the stresses set up on short-circuit. If even moderate movement of the stator bars occurs, cracking of the insulation is probable, especially if the insulation is of some age, setting up a

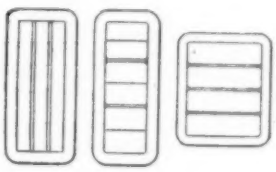


FIG. 1. FIG. 2. FIG. 3.

FIG. 1.—THREE-TURN BAR DIVIDED RADIALLY.

FIG. 2.—THREE-TURN BAR DIVIDED AXIALLY.

FIG. 3.—ONE-TURN, FOUR BARS IN PARALLEL.

defect which will develop sooner or later into serious trouble. In fig. 1 is shown a three-turn per slot winding for a 5,000-KW. machine, 6,600 volts between phases. The three copper tapes are arranged lengthways in the slot, giving a stiff bar with which there was no trouble on short-circuit. In fig. 2 is shown the winding of another machine of similar size, laminated across the slot, and of better design for reducing the eddy currents, but the bar is not so rigid. Both machines worked under similar conditions, and were connected to the same busbars, but the winding shown in fig. 1 gave no trouble on short-circuit, whilst the winding in fig. 2 repeatedly broke down.

On the multiple-bar and crushed-strand construction, difficulties occur with stator bars of considerable section. The conductors do not nest firmly together, and a tight mica wrap around them cannot be made. An example is shown in fig. 3, where the conductors were slack within their insulation, and in less than three years the insulation was worn away at the corners and caused a breakdown to earth at a very moderate working pressure.

The latest method of constructing stator bars is a more complete development of lamination. The stator bars are divided radially into several copper tapes, each separately insulated, and each tape is connected to another tape in the several bars forming the winding pitch at the ends of the stator. At each joint the tapes are twisted relatively to each other, giving a complete change of position in each complete phase winding from the star point to the main terminal.

This construction eliminates eddy currents and gives a uniform distribution of current in every section of the stator bar. It has the additional advantage of small joints, which enable the tapes to be fusion-welded together. The only large joints occur at the star points and at the main terminal connections, and these can be arranged well out of the revolving field. However, a bar laminated so completely has little stiffness or mechanical strength and requires very careful support.

Heating and Fire Risk.

With the old type of low-speed generator the fire risk was not considerable, as the proportion of inflammable material was small. With a modern turbo-alternator, owing to the high speed and compact design with small volume of active material, a very considerable portion of inflammable insulation is built into the machine. The stators have usually two-pole windings, consequently about 50 per cent. of the stator winding length is usually taken up by the connectors between the stator bars. These connectors are purposely spaced in an open manner to allow the cooling air to circulate, and the air is circulated at the speed of a tornado and is constantly renewed by the fans. The inflammable character of the winding may be augmented by oily vapour and dirt carried into the machine by the ventilating air and deposited as sticky material on the conductors. A fire once started at or near the end connectors is immediately swept round the openly spaced windings, and their destruction is a matter of only a few seconds.

Ventilation Troubles.

The amount of air required to carry away the internal heat is dependent upon the internal losses and upon the permissible temperature rise. Allowing a rise of 50 deg. F. in the cooling air, and a loss of 4 per cent. in the generator, about 4 cu. ft. of air per minute per kilowatt of output is sufficient, and this allows for a certain amount of the air being short-circuited within the machine. Except under very exceptional conditions some form of filtering and cooling the air is necessary. The amount of dust caught by a dry filter from an air blast of 40,000 cu. ft. of air per minute has been found per week of continuous working to be 5 lb. in the centre of London and 2 lb. at the outskirts of London.

Unless this dust be removed, it is sufficient to choke up the narrow air passages in the rotor and stator, which passages can be cleaned only with considerable difficulty, even when the rotor is removed.

The correct distribution of the air after entering the machine is a matter of difficulty. Even should the various air currents be correctly distributed when the machine is new, deposits of dirt after use will soon alter the air distribution, and the effect of incorrect distribution of air is of serious practical importance.

The temperature of the ventilating air leaving the machine indicates roughly the amount of heating of the machine, but gives neither the maximum nor the average temperature, as the temperature gradient is unknown. If the separate discharge temperatures of each air current were known, a better indication would then be obtained of the hottest part of the machine.

Suggested Lines of Improvement.

From the operating point of view, the requirements of modern turbo-generators are (1) reliability, (2) efficiency, (3) ease of operation. Reliability calls for machines which shall be fireproof, the coils of which cannot break down or overheat, the insulation of which shall not fray, crack or deteriorate, and the electrical joints of the machine shall be so constructed that there is no chance of their giving way under load. Most operating engineers would consider reliability the most important of the above conditions, and would be willing to obtain it at the sacrifice of some electrical efficiency.

Ease of operation requires some better means of knowing what is happening inside the machine. It ought to be possible to determine continuously, with some accuracy and by simple means, what is the temperature of any part of the machine, and it is desirable to anticipate breakdowns by the indication of rising temperature of the faulty part, or otherwise, before the fault develops.

The output of the machine should be independent of air temperatures, and if possible there should be some reserve of capacity to meet sudden overloads.

Rotor coils' centrifugal force.—When it is realised that a pressure of over 2 tons per sq. in. may be encountered, and that the insulation must stand continuously a temperature of 200 deg. F., it will be seen that the insulation problem is not one of easy solution. The choice at present is restricted to mica and various forms of hard paper. The coil should be made of as great a width as possible, and the separate turns laid flat upon each other. The support of the coils against distortion at the end of the loops can be prevented by substantial metal packing between the loops.

The safest band over the coils would be one of drawn steel tape, which would require centering by other means than the coils themselves. With a laminated tape band, each turn can adjust itself to the strains upon it.

Stator cores.—The trouble of soft cores is usually due to the end plates being of insufficient stiffness, and as they are generally attached to the frame only at the periphery, there is a considerable spring across the face of the plate. In the case of cores of considerable radial depth, one or more rings of insulated bolts may be necessary in addition, in which case all electrical contact with the bolt heads and nuts on the end plates must be carefully avoided. Stronger supports should be provided for the teeth.

Stator windings.—The end connections, if attached to weak laminated stator bars, are difficult to stay adequately. Usually fibre spaced blocks are laced between the ends of the stator bars at the junction with the end connectors; these give mutual support between the bars in a circumferential direction, but stresses on short-circuit are also radial from the centre, and in this direction the space blocks give but little support. The remedy is to provide continuous coil supports having winding slots for the entire length of the end connectors.

Joints.—In the ideal machine all the joints would be fusion-welded, except possibly in the case of the largest joints, where clamped and soldered connections would be permissible if well removed from the rotating field.

Heating and fire risks.—The relation of the temperature to the useful life of the insulation is of great importance. A reduced temperature gives a greatly increased life.

It would appear that for large machines working continuously night and day for months together, a temperature of 150 deg. F. has much to recommend it from the point of view of capacity to meet sudden overloads and long life of insulation.

Having the fire risk in view, all inflammable packing insertion and all fibrous insulation should be avoided in both stator and rotor. The ideal insulation is yet to be found, but it would have a substantial body of mica built up without inflammable gum or varnish and with some degree of flexibility. The binding material of the mica and packing must have a high thermal conductivity and suitable specific inductive capacity to give a uniform electrical pressure gradient through the mass of insulation.

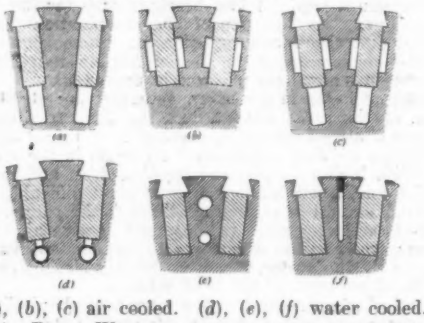
Ideal Machine.

Various designs have been proposed using liquid cooling. Whilst the majority of them are of foreign origin the initial adaptation of water cooling to modern machines is to be credited to Messrs. C. A. Parsons & Co., Ltd.

All the liquid cooling designs on record appear to deal with the problem of heat dissipation as an adjunct to air cooling. If, for the moment, the principle of liquid cooling be accepted and be completely developed as a practical feature, a number of important modifications at once become possible. Air ventilation, with the difficulties of cooling and cleaning, becomes unnecessary, and the fire risk of machines largely disappears if there be no air to feed the flames. By splitting up the water paths in the machine, and by providing adjusting cocks in the water supply to each cooling device, it becomes a simple matter to determine the temperature of each part of the machine and to adjust the water flow to give a uniform temperature with elimination of hot spots, and having regard to the superior cooling effect of water over air, a lower temperature would be possible with enhanced life of the insulation.

A further and great advantage would be in the provision of continuous supports to the end connections of both stator and rotor windings, which at present are the weakest features of most generators.

Various designs of cooling rotor windings have been drawn out for a modern high-speed rotor (fig. 4).



(*a*), (*b*), (*c*) air cooled. (*d*), (*e*), (*f*) water cooled.

Fig. 4.—Rotor Winding, various methods of cooling.

Taking the ordinary air velocities in rotor ducts as 10,000 ft. per minute, and a moderate water velocity of 500 ft. per minute, the relative cooling capacities of the streams of air and water are as shown in the table below. The size of cooling ducts are taken as large as can be constructed with the winding slots shown.

Arrangement.	Proposed by	Relative cooling capacity.
Fig. 4 (*a*)	Ordinary arrangement	1
„ 4 (*b*)	Siemens	0·8
„ 4 (*c*)	Schuckert	1·8
„ 4 (*d*)	Parsons	54
„ 4 (*e*)	Siemens Dynamo Works	83
„ 4 (*f*)	Author	89

The actual heat-abstracting powers of the two sets of conditions per degree F. rise in temperature of cooling medium for the velocities stated are:—

Air: 1,266 therms per minute per sq. in. of air duct.

Water: 216 therms per minute per sq. in. of water duct.

The capacity of water over air cooling is very marked, as might be expected, and may be in excess of the capacity of the insulation to conduct the heat. A rotor constructed with cooling ducts as shown in fig. 4 (*f*) is detailed in fig. 5, where water-cooled supports are shown for the end loops against side slip.

Water cooling for the stator does not appear to have been developed to any great extent.

If full advantage is to be taken of water cooling, it would appear desirable for the cooling arrangements to be in close proximity to the coils, with very low-resistance heat paths. Designs have been developed by the author upon these lines.

In fig. 4 (*f*) the heat from the rotor coils is directly transmitted to the iron tooth, which would be made slightly wider

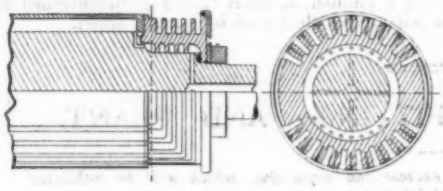


FIG. 5.—ROTOR WITH SEPARATE COIL SUPPORTS, WATER-COOLED.

than usual to compensate for the loss in section where the water duct is milled out of the solid tooth; the top of the duct is closed by a steel plug, fusion-welded in place.

Fig. 5 shows a rotor with teeth cooled as described, and provided with separate bronze coil supports at each end of the core. The supports would provide continuous slots for the end loops of the rotor coils. The metal teeth between the coils give substantial support at the rotor periphery for supporting and centering flexible steel tape bands. The steel ring over the end flange is arranged to give a mechanical anchor for the end of the steel binding tape.

(*To be concluded.*)

DISCUSSION IN LONDON.

Mr. A. B. FIELD said that the suggestions put forward by the author for a water-cooled generator were not new, and they could not be adopted at the present time because they would have to await improvements in details. By that he meant improvements in methods of insulation upon which the whole thing depended. It was his opinion that the present methods of air-cooling generators would certainly be superseded. A method worthy of consideration was that of incorporating an air circulator and cooler in the generator itself; such a device had, he thought, greater possibilities than the author attributed to it. He agreed that in, say, 15 years time present practice would be considered quite as antiquated as that of 1904 was considered to-day.

Mr. E. W. DICKINSON's opinion was that the author's propositions would not solve the problem; some considerable time would elapse before the introduction of the water-cooled generator would be possible. With regard to the suggested use of solid strip in place of binding wire, he thought the same objection, namely, the possibility of "wiping" end coils, would apply to both. Also concerning the merits of solid and flexible couplings, the former were, in his opinion, much preferable. One of their greatest troubles was, he thought, that of workmanship. To-day the average workman was nothing like so careful in carrying out his work as he used to be a few years ago. Carelessness and low-grade workmanship were responsible for a great many faults; if they could be sure of the workman putting high-class work in the machine the majority of common faults would automatically disappear.

Mr. G. W. PARTRIDGE was afraid that the author must have been very unfortunate in his machines. The statement that generally the rotor and its shaft were turned out of a single forging held good only for machines up to 12,000 KW. and 3,000 R.P.M.; beyond that size the plated construction was, in his (the speaker's) opinion, preferable, so that the inside of the rotor could be seen, and what was going on inside could be noted. He regretted the attack in the paper on the Parsons' flexible coupling; personally he had always preferred a flexible coupling, especially for large machines. One serious form of trouble had been omitted from the paper, namely, a single-phase short-circuit, which would result in the burning up of the wedges between the coils and would also disturb the end windings. He had fortunately been free from most of the troubles cited by the author, although his service was perhaps one of the most severe. With regard to water-cooled generators, such machines would be very expensive, and the problems to be overcome in making and maintaining water-tight joints would be difficult. Condensation would also be a serious difficulty unless the machine were kept working on a constant load, and that was not always possible. Moreover, he was certain that trouble would be experienced with deposits and corrosion due to the cooling water and the space taken up by ducts for the latter could be utilised to much better purpose if used in conjunction with air cooling.

Mr. A. M. TAYLOR assumed that it was vital that alternators should be absolutely reliable under all conditions. The alternator makers were bound to defend themselves against any charge of unreliability, and they would probably be content if it could be shown that only one alternator in five broke down within, say, three years of purchase. But he (the speaker) knew of at least one case where, with the very best modern alternators, even half this reliability was not attained. He submitted that the degree of reliability obtained with locomotives on main-line railways was something like 100 times as great. He suggested that as, in the near future, they were to have stations generating at 30,000 to 60,000 volts, which would necessitate step-up transformers, it was a question whether the transformers could not be efficiently used to improve the reliability of the generators. Suppose, for example, that, instead of earthing one end of each generator coil, the coil were insulated at both ends and the two ends taken out to a corresponding coil on the primary of the transformer and that the midpoint of this coil were earthed. They would then at once halve the potential stresses between any part of the generator winding and earth. The arrangement would really be the equivalent of six phases on the generator, though there would be only three coils, as at present. Suppose, further, that a second three coils of intermediate phase were added to the generator, then, for the same kilowatts, the voltage of all six coils could be again halved, thus quartering the stresses to earth. The second three coils would be connected to a second lot of primaries on a second transformer; and in order to rectify for the phase displacement, the second transformer would have its H.T. side in delta, while that of the first transformer would be in star, both being coupled to the same busbars. Besides quartering the stress to earth on the generator windings, the arrangement would have the decided advantage of reducing the tendency of the sound coils on the generator to deliver energy to the faulty coils, for, in the case of coils that were feeding different transformers, there were two primary and two secondary reactances in series. He believed that when the great advantages of multiphase transmission were appreciated, this (multiphase) form of transmission would be adopted for all long-distance work, and in such a case the 6-phase, double-star generator winding mentioned above could be put direct on to the (cable) line, and this would at once give 70 per cent. better regulation on the cable system and 58 per cent. of the line losses, or conversely greater distances could be covered for the same amount of copper. In cases where three existing cables ran to an existing sub-station, approximately 70 per cent. more power could be transmitted by running the cables as a 6-phase system. At the sub-station end an ordinary 3-phase transformer could be used to give a 3-phase supply. The special generator could be dispensed with if a transformer were introduced between the busbars and the line. A 12-phase, long-distance transmission line could be carried out with two 6-phase cables, and would reduce the line losses to 29 per cent. of that of the 3-phase system and improve the regulation 340 per cent.; or conversely the distance of transmission could be extended 3¼ times for equal copper investment.

Mr. W. MCCLELLAN, O.B.E., who was particularly interested in the paper from the point of view of electric ship propulsion, said that the author had not exaggerated the difficulties in this connection. This was at once apparent when it was remembered that the air trunk pipes that would be necessary for cooling a large electrically-propelled battleship would have diameters approaching 20 ft. Moreover, the cooling of large ship's motors was particularly difficult, as they were situated in such confined space at the stern of the ship. Air ducts on board ship also multiplied the problems encountered in connection with water-tight compartments and bulkheads. In America maximum speed of vessels had been sacrificed to obtain efficient cruising speeds.

Dr. S. P. SMITH pointed out that if the buyer insisted upon having the cheapest machine he could obtain, then he had no one to blame but himself when breakdowns occurred. Further, if the practice of allowing a lower factor of safety for an electric generator than for any other type of machine continued, they could expect little else than trouble. On the other hand, it should be pointed out that there were machines which had been running perfectly for years without any trouble whatever. Some of the faults enumerated by the author were out of date; slack cores, for instance. Surely they should not have to be told how to make cores in these days. They should be on their guard against being misled by statements that water was a better cooling medium than air. For instance, they might cool the iron portions of the machine in direct contact with the water more efficiently and yet the copper conductors might be no better off due to the thick mica insulation preventing the heat escaping to the water. The whole problem was one of insulation. The author's proposals had many good points, but in his (the speaker's) opinion a water-cooled generator as proposed in the paper would not be a success.

Mr. F. H. CLOUGH complained that many of the weaknesses enumerated in the paper were out of date; the author advocated low temperatures, and yet he proposed the use of windings which would lead to high temperatures. There was also much misconception regarding where stresses in the windings really occurred. It should not be forgotten that the proposition of a new type of machine was quite a different task to that of persuading a customer to buy the said new machine. The state of affairs was not really so bad as was

suggested by the author, but his paper would lead to very serious thought. There was no doubt that water cooling would be adopted eventually, but they were not ready for it yet, and if it came too soon it might lead to serious trouble, perhaps even more serious than that experienced to-day.

Mr. J. SHEPHERD, in reply, explained that the paper was put forward to see if they could not from two points of view build better machines; first cooler, and secondly safer machines. With regard to the faults mentioned being out of date, he could only say that he had personally experienced all but one of them, and that had been included at the express request of a friend. It was his opinion that in, say, 10 years' time air cooling would have gone out of use; that method weakened the machines on account of the large number of air holes that were necessary, and it also led to the accumulation of dirt inside the machine. The air-circulating system suggested by Mr. Field had its good points, but no method except water cooling would allow of the insulated conductor being supported along its entire length. The user found the insulation to be the seat of all disorders. He agreed with Dr. Smith that a larger margin of safety should be allowed; a conductor should be supported for the whole of its length and not only for part of its length as was done at present. Bars should be so shaped to assist insulation which should be the same along its whole length. Present practice resulted in the straight portion of the bar being more efficiently insulated than its curved portions. Wire bands were superior to solid steel rings, because during the process of drawing the wire was thoroughly tested. On the other hand, alloys like nickel and chrome steel were comparatively new, and the effect on them of prolonged heat and continued stress had yet to be determined. With regard to the unsuitability of the flexible coupling, he instanced a number of firms that had discontinued its use.

The paper was illustrated by lantern slides.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Water-cooled Cable System.

In order to cool high-tension cables run through the walls of a tunnel in Cincinnati the Union Gas & Electric Co. has installed a system of water pipes which will tend to prevent any excessive cable heating. The system, fig. 1, consists of 25 1.5-in. (37-mm.) pipes running parallel to the ducts. At each end of the horizontal section of the tunnel, which is 64 ft. (19 m.) long, the pipes project into the tunnel chamber and are fitted at their ends with removable plugs. About 7 in. (15 cm.) from the end of each pipe tees are inserted for inlet and outlet connections to manifolds. These manifolds are connected to a gravity or forced-feed circulating system as conditions dictate.—*Electrical World.*

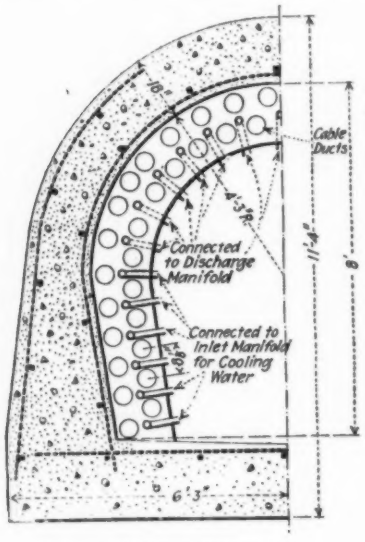


FIG. 1.—COOLING SYSTEM FOR CABLE DUCTS.

when the truck is withdrawn all live parts mounted on the fixed section are entirely covered in by a steel shutter, which moves into position, thus covering the plug-switch holes.

Where busbars are required, these are accommodated in a separate chamber at the top of the fixed cubicle, and are entirely covered in. Inspection covers are provided to enable the busbars to be inspected when necessary. Any desired combination can be arranged with the truck type cubicle illustrated so as to form a complete main switchboard.

The "Melton" Lantern.

MESSRS. FALK, STADELMANN & CO., LTD., of 85, Farringdon Road, E.C. 4, have produced a lantern, fig. 3, designed for street and shop front lighting. The reflector is designed to give a good light distribution, and the lower section of casing provides a cooling chamber to prevent overheating. In addition to the ventilating points provided round the globe seating

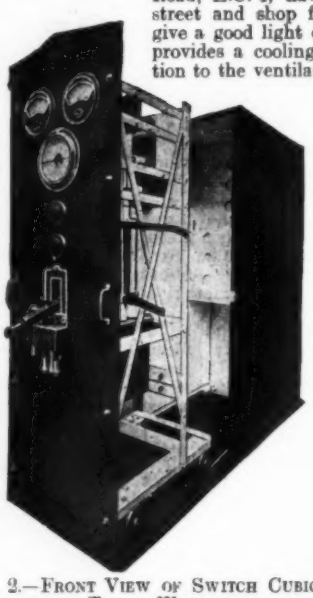


FIG. 2.—FRONT VIEW OF SWITCH CUBICLE WITH TRUCK WITHDRAWN.

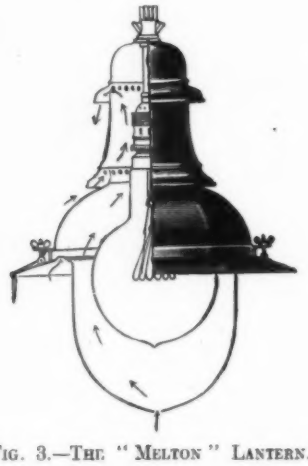


FIG. 3.—THE "MELTON" LANTERN.

G.E.C. Switch Cubicles.

For the control of three-phase machines and feeders up to 6,600 volts where floor space is limited the GENERAL ELECTRIC Co., Ltd., of 67, Queen Victoria Street, E.C. 4, manufactures "truck" type switch cubicles as shown in fig. 2, in which the "truck" is seen withdrawn for inspection, cleaning, &c. The construction allows of their being placed directly against a wall, as a passage way behind is unnecessary, neither are special foundations required. The cubicles are constructed of steel, so that the equipments are rendered fireproof; no marble or slate is used in their construction, all terminals, busbars, isolating switches, &c., being supported by means of porcelain insulators. They are designed to accommodate the usual instruments, oil-break switches, isolating plug switches, transformers, and sealing boxes; the whole of this apparatus (excepting the sealing boxes) together with the inter-connections and small wiring, are mounted on a movable truck with wheels fitted with ball bearings. When the truck is withdrawn the whole of the gear is rendered "electrically dead," and easy access is afforded to facilitate renewals, adjustments, cleaning operations, &c. By means of an interlock it is made impossible for the truck to be withdrawn or placed in position with the oil-break switch in the "on" position. Furthermore,

under the cap of the lantern, the body is ventilated midway to promote a cooling current of air round the neck of the lamp. All ventilation points are adequately protected against the weather.

Central Suspension for Street Lighting.

The accompanying illustration shows the latest installation of street-spanning gear carried out by the LONDON ELECTRIC FIRM, Brighton Road, Croydon, viz., at Hove, near Brighton. The gear consists of a simple set of span-wire fittings, which has been devised for use without lowering gear, the cable being led down the wall in screwed conduit and finished off with a watertight switch and fuse. The cable is so arranged that there is no possibility of water trickling down the wire into the lamp. The efficiency of central-suspension lighting, and its advantage in eliminating posts with attendant obstruction and risk of collision by passing vehicles, will no doubt be more appreciated with the advancing speed and volume of street traffic, and also in view of the Road Board's recent pronouncement in favour of this system, and the powers which are being sought to obtain compulsory rights for attaching fixtures to frontagers' buildings. Varying sizes of buildings are no bar to the system, as short poles can be

erected on a low building, or attachment can be made to a chimney stack or the like, where opposite buildings are not

FIG. 4.—CENTRAL SUSPENSION AT HOVE.

of equal height. Similar gear has been supplied to the City of London and many other places.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Unspeakable Bosh.

I notice your leaderette of the 2nd inst. entitled "Where angels fear to tread," commenting on the *Daily Mail's* account of Mr. Steele's scheme of generating electricity. You appear, however, to have missed another gem in the same paper (I am sorry I cannot refer you t othe particular date of their issue) in which they describe a "Fuelless motor bicycle": this, briefly, is to operate by means of a hydraulic cylinder upon which the saddle is fixed, and which is connected through a pump to a water motor. The bumping along the road causes the weight of the rider to operate the pump, and produces one horse-power. If there are two pumps installed, it produces two horse-power, and if three pumps, three horse-power.

As you say in your article, moderate language is utterly inadequate to the occasion, and this is specially so when dictating to a lady typist.

T. C. Parsons.

Glasgow, *January 6th*, 1920.

Transformer Oil.

In the course of a number of investigations into cases of transformer breakdown, we have come to the conclusion that many engineers find difficulty in deciding when to change the oil in their plant. We therefore put forward a few suggestions for testing the condition of transformer oil, in the hope that they may be of interest.

The oil should be sampled at regular intervals, say, once in three months, preferably from a cock near the bottom of the tank. The first pint or so drawn should be returned, and then a small quantity should be mixed with twice its volume of natural petroleum spirit (not cracked spirit, shale spirit, or benzole) in a clean, well stoppered bottle, and allowed to stand 12 hours in a cool place.

This treatment will cause any sludge which may be forming in the oil to fall to the bottom as a deposit, and if the bottles are kept, the amount of deposit from any test may be compared with that from preceding tests.

When an oil oxidises, sludge begins to form long before it begins to deposit—a quantity being held in solution—and it should, we take it, be the aim of the engineer to change his oil just before it reaches saturation point. Since warm oil will hold very much more sludge than cold, it follows that a good deal can be learnt by simply cooling samples overnight and noting the amount of turbidity.

A close watch should also be kept upon the dielectric strength, or what in the case of high-class oils amounts to the same thing, upon the dryness of the oil. It is not sufficiently appreciated that during oxidation of petroleum water is formed as well as sludge. This fact would have forced itself upon the attention of engineers long ago were it not that the warmth of the transformer generally causes the moisture to evaporate. Whether the moisture escapes as quickly as it is formed depends, however, upon the design of the transformer case.

A rough test is to heat the oil in a test-tube, when a crackling and frothing indicates moisture, but this is only sensitive enough to indicate a really dangerous proportion. A much better method is to determine the dielectric strength by raising the voltage to breakdown point between a pair of electrodes immersed in the oil at a known distance apart. When traces of moisture are present small sparks traverse the gap at a voltage considerably below that of complete breakdown.

We do not attempt to propose rigid rules for managing the oil insulation of a transformer, but we think that by studying his oil in the manner indicated above, an engineer may acquire experience which will help him in guarding against breakdown.

Alexander Duckham & Co., Ltd.

London, E., *January 7th*, 1920.

Relativity.

I do not rightly know if I have understood the nature of the difficulty that arises in your article of the 9th inst. on "Relativity," but it seems to me that all difficulties disappear if it is remembered that the higher dimensions are not used in the "mystic" sense of nineteenth century mathematics. The time function is treated simply as a spatial quality, and not as a coefficient. The three-dimensional treatment of space itself is, of course, purely arbitrary. A creature physically constituted like H. G. Wells's "Martian" (and equally egotistic) would probably devise a radial system with or without the integral treatment of the time function. The same writer has treated time as a spatial quantity in the "time machine" with fantastic results, and has perhaps intuitively appreciated the true constitution of space in the curious short story of the man whose "optical field" is shifted by lightning stroke while experimenting between the poles of a huge magnet.

It would seem that we must treat time-spatial relations as a product of psychic-motion scrapping the ether hypothesis. Upon the extraction of motion and, or, the psyche (whatever it may be), space and time would collapse like a burst bubble as a result of the rupture of all tensions. This, however, is ultimate and by-the-way. It would be interesting to hear some practical views upon a theory which to me appears intuitively satisfactory, and which will take a deal of refutation.

Wilfrid J. Jones.

Eastleigh.
January 12th, 1920.

The "Lesco" Lampholder.

As the patentee of the "Lesco" holder, may I venture to reply to Mr. Turnbull's criticisms on this holder?

Before doing so I should like to point out that in the correspondence with Mr. Turnbull the point of his criticism has been misunderstood. The arguments the Lesco Co. put forward were based on the assumption that Mr. Turnbull was objecting to the method by which the shoulder which supports the shade was attached to the body, whereas he was really objecting to the method that was used to join the two parts together. Of course, there is no suggestion that the top and bottom parts of the holder should be a tight fit in order to take weight off the indentations.

With regard to this point, now that we understand what he really means, our answer is that the heaviest shade, holophane or any other kind, that is likely to be put on a holder will not exceed 3 lb. in weight, and a deep conical opal 12-in. shade weighs 1 lb. The Lesco holder, Mr. Turnbull will find, will carry 50 lb. weight. Surely this is a sufficient safety factor to allow for corrosion or any other cause.

Mr. Turnbull goes on to say that this is more important in that the holder is made from light spinnings and not from castings. This remark is a deliberate misstatement of fact. In our letter to Mr. Turnbull of December 29th, we gave him the information definitely that the "Lesco" holder is made of solid-drawn brass tube throughout. It is not a spinning, nor is it a stamping job. There is more metal in the Lesco holder than in the best quality English holders. Mr. Turnbull talks of holders being made from castings; the quantity of holders made from castings in this country or anywhere else is probably less than 5 per cent. of the total output.

In conclusion, whilst I do not object to Mr. Turnbull going to the public Press to express his views on the mechanical design of the holder, what I do object to is his attempting to convey the impression that the holder is made of light stampings, and that it compares unfavourably with the best quality of English holders, whereas in reality it contains more metal and is quite as substantial in every way.

Vernon Hope.

Manchester.
January 12th, 1920.

The Fuel of the Future.

In reading the articles referred to by "Economy," whose letter you published in your issue of January 2nd, I cannot see that there is anything that Mr. Klemens said in those articles which would have the effect of discouraging electrical men from emulating the gas engineer by salving the valuable by-products of coal to the utmost extent.

Mr. Klemens does not attempt to deal with that aspect of

the problem, and the main lesson to be learnt from his articles, as I understand them, is that it is a fallacy to argue that electrically-produced heat is dearer than gas-produced heat, merely because British Thermal Units can be produced by gas more cheaply than by electricity.

In the case of gas heating, British Thermal Units are blown to waste, whereas in the case of electric heating, all heat produced can be usefully employed.

If we are to get all we possibly can from the coal, then we must have gas, but the argument is that it would be better utilised in the power house than in the home.

Super-Economist.

January 7th, 1920.

NEW PATENTS APPLIED FOR, 1919-1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STAPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

32,764. "Method of altering electrical conductivity of metals." F. H. LOKING. December 31st.

32,767. "Electric cut-out devices." A. J. AMEY and H. V. FROTT. December 31st.

32,770. "Means for measuring electric currents." M. B. FIELD. December 31st.

32,776. "Sparking plugs." C. L. BINNS. December 31st.

32,783. "Electric generators and motors." VAN RADEN & Co. and R. RANKIN. December 31st.

32,789. "Indicators for electrolytic cells." I. H. LEVIN. December 31st.

32,790. "Separators for electrolytic cells." I. H. LEVIN. December 31st.

32,791. "Electrolytic cells." I. H. LEVIN. December 31st.

32,792. "Feeding attachments for electrolytic cells." I. H. LEVIN. December 31st.

32,793. "Electros." I. H. LEVIN. December 31st.

32,794. "Electrolytic apparatus." I. H. LEVIN. December 31st.

32,812. "Radio navigational apparatus, &c." H. L. CROWTHER and J. EPSKINE MURRAY. December 31st.

32,813. "Radio-receiving systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) December 30th.

32,845. "Method of fixing insulating rings on shafts or cores." NAAMLOOZE VENNOOTSCHAP ELECTROTECHNISCHE INDUSTRIE VOORHEEN, W. SMIT & Co. December 31st. (Holland, February 20th, 1915.)

32,853. "Method for electrolysing a solution of nickel salt." C. HEBERLEIN. December 31st.

32,879. "Electric cigar lighters, &c." QUAIN ELECTRIC Co. and J. R. SPINK. December 31st.

32,886. "Apparatus for electrolysis of metal salt." FREDRIKSSTAD ELEKTROKEMISKE FABRIKER AKTIESELSKABET F.E.F. December 31st. (Norway, February 13th.)

44. "Meter for measuring, recording and indicating quantity of electrical energy on electrical circuit." W. W. LACKIE. January 2nd.

52. "Enclosed-bulb electric devices." O. DURDLE, GENERAL ELECTRIC Co. January 2nd.

60. "Treatment of paper, &c., for electrical, chemical, &c., purposes." S. BRYDON. January 2nd.

64. "Electric battery." A. CAYROL and P. ODION. January 2nd. (France, April 25th, 1914.)

66. "Process for manufacture of electric insulating material." E. F. A. BULTEMANN. January 2nd. (Germany, January 29th, 1918.)

72. "Sound amplifiers." J. B. MITCHELL. January 2nd.

94. "Valve amplifiers and inter-valve transformers." G. A. MATHIEU. January 2nd.

103. "Electric air-heating devices." A. REMARTINI. January 2nd.

104. "Sparking plugs and manufacture of same." G. N. HALL and H. G. RAMSELL. January 2nd.

127. "Induction manifold for internal-combustion engines." G. SCOTT. January 2nd.

128. "Methods of electric distribution with alternating currents." A. M. TAYLOR. January 2nd.

151. "Signalling systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) January 2nd.

152. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON, F. H. CLOUGH, J. HUTT and H. W. TAYLOR. January 2nd.

161. "Means for starting internal-combustion engines, also for generating electric current." W. S. JEAL. January 2nd.

170. "Dynamo-electric machines." A. H. MIDGLEY and C. A. VANDERVELL & Co. January 2nd.

190. "Indicators or annunciators." F. G. BELL and STERLING TELEPHONE & ELECTRIC Co. January 2nd.

209. "Arrangements for offering greater impedance to direct than alternating currents." AUTOMATIC TELEPHONE MANUFACTURING Co. and P. N. ROSEBY. January 3rd.

226. "Electric kettles, &c." R. W. COAN. January 3rd.

243. "Insulators." BRITISH THOMSON-HOUSTON Co. January 3rd.

244. "Controlling devices for alternating-current dynamo-electric machines." BRITISH THOMSON-HOUSTON Co. and H. W. TAYLOR. January 3rd.

254. "Electric oscillation arcs." B. BINYON and RADIO COMMUNICATION Co. January 3rd.

264. "Electric switches." Sir G. T. BUCKHAM and Sir A. T. DAWSON. January 3rd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

7,176. DISTRIBUTORS FOR HIGH-TENSION IGNITION DEVICES. Bosch Akt. Ges. R. May 26th, 1917. (116,270.)

8,200. ROTARY ELECTRIC MACHINES. K. Nobuhara. May 16th, 1918. (Convention date not granted.) (116,886.)

10,453. METHOD OF AND APPARATUS FOR CHARGING MATERIAL OF ELECTRO-OSMOTIC APPARATUS FOR REMOVING LIQUIDS FROM SUBSTANCES. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,815.)

10,458. APPARATUS FOR ELECTRO-OSMOTICALLY REMOVING LIQUIDS FROM MATERIALS. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,819.)

10,459. APPARATUS FOR ELECTRO-OSMOTICALLY REMOVING WATER. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,820.)

12,769. ELECTRIC LIQUID HEATING APPARATUS. I. Sordi. August 3rd, 1918. (136,198.)

14,078. DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. and H. W. Taylor. August 30th, 1918. (136,202.)

14,715. ELECTRICAL SYSTEM FOR GENERATING INTERMITTENT HIGH-TENSION CURRENT IMPULSES FOR IGNITION PURPOSES, WITH OR WITHOUT LOW-TENSION CURRENT FOR BATTERY CHARGING, LIGHTING, AND THE LIKE. C. H. Tower. September 10th, 1918. (136,203.)

16,582. AUTOMATIC TELEPHONE SYSTEM. W. Cross. (D. S. Hulfish.) October 11th, 1918. (136,207.)

18,216. ARRANGEMENT FOR EVENLY DISTRIBUTING SINGLE-PHASE LOADS BETWEEN THE PHASES OF A POLYPHASE SUPPLY SYSTEM. U. Magini and F. Bassanese. November 6th, 1918. (136,211.)

18,715. ARMATURE WINDINGS OF ELECTRIC ALTERNATING-CURRENT MACHINES. British Lighting and Ignition Co. and E. C. Turner. November 14th, 1918. (136,215.)

20,000. CONTINUOUS FEED FOR ARC LAMPS. A. H. Standeford. December 4th, 1918. (136,220.)

20,379. ARMATURES AND POLE SHOES FOR MAGNETS. Siemens Bros. & Co. and L. de M. G. Ferreira. December 7th, 1918. (136,240.)

20,452. SPARKING PLUGS. K. E. L. Guinness. December 9th, 1918. (136,247.)

20,458. SOUND TRANSMITTING AND AMPLIFYING DEVICES FOR GRAMOPHONES AND THE LIKE. W. R. Free. December 9th, 1918. (136,249.)

20,619. TROLLEY HEADS FOR ELECTRIC TRACTION. J. B. Parker and J. Smith. December 11th, 1918. (136,260.)

20,641. PROTECTIVE HEAD COVERINGS OR MASKS FOR USE IN WELDING OPERATIONS. C. J. Holstag. December 11th, 1918. (136,263.)

20,988. ELECTRIC ACCUMULATORS. H. F. Joel. December 16th, 1918. (136,282.)

21,139. VISUAL ELECTRICAL INDICATORS FOR COLLIERIES AND OTHER MINES. J. KING. December 18th, 1918. (136,287.)

21,457. COMMUTATORS FOR DYNAMO-ELECTRIC MACHINES. E. J. Harman and E. Le Bas. December 21st, 1918. (136,303.)

1919.

511. SPARKING PLUGS. C. C. Bryan. January 8th, 1919. (136,327.)

1,288. MEANS FOR DRIVING A DYNAMO AND ACCESSORY PARTS OF AN ENGINE. M. Birkigt. January 17th, 1919. (136,339.)

1,404. TELEPHONE REPEATER SYSTEMS. K. E. Edgeworth. January 20th, 1919. (136,340.)

2,369. TELEPHONIC TRANSMITTERS. B. S. Cohen. January 29th, 1919. (136,360.)

2,785. ELECTRIC FUSES. W. A. Coates and Metropolitan-Vickers Electrical Co. February 5th, 1919. (136,367.)

2,901. CONTROL OF ELECTRIC MOTORS DRIVING RECIPROCATING MACHINES SUCH AS PLANES AND THE LIKE. G. Stirk, R. Stirk, and J. G. Stirk. February 6th, 1919. (136,373.)

2,928. APPARATUS FOR NOTCHING OR PUNCHING CORE-PLATES FOR DYNAMO-ELECTRIC MACHINES AND THE LIKE. Lancashire Dynamo and Electric Co. and R. S. McLeod. February 6th, 1919. (136,374.)

6,051. ELECTRIC SOLDERING-IRONS. O. Stalhane and O. O. Kring. March 11th, 1919. (136,406.)

8,914. ELECTRIC SELECTIVE-SWITCHING APPARATUS. International Electric Co. and F. R. Baldock. August 14th, 1918. (Divided application on 126,775.) (136,436.)

9,333. SOCKET TUBES FOR ELECTRICAL CONNECTORS, WALL SOCKETS, AND THE LIKE. C. L. Arnold and C. R. Belling. April 12th, 1919. (136,439.)

9,741. GALVANOMETERS AND THE LIKE. W. H. Apthorpe and Cambridge Scientific Instrument Co. April 16th, 1919. (136,445.)

12,041. METHOD OF AND APPARATUS FOR OPERATING CABLE OR OCEAN TELEGRAPHY. H. Angel. May 14th, 1919. (136,094.)

12,841. ELECTRICAL SWITCHING MEANS. E. A. Graham, W. J. Rickets and E. A. Santleben. May 21st, 1919. (136,101.)

12,900. ELECTRICAL INSULATORS. P. Venturini. May 22nd, 1919. (136,102.)

13,024. WHIPPING FOR TELEPHONES AND TELEGRAPH CABLES. Johnson & Phillips and A. I. Tracey. May 23rd, 1919. (136,463.)

13,026. RELAY FOR ELECTRIC CIRCUITS. D. A. Christian. May 23rd, 1919. (Addition to 131,413.) (136,103.)

14,180. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. R. Soyer. June 5th, 1918. (127,829.)

14,392. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. W. V. Rutter, A. Farrington and G. M. Nicklin. June 6th, 1919. (136,109.)

14,583. ELECTRO-THERAPEUTIC APPLIANCES. A. H. Hewitt. June 10th, 1919. (136,110.)

14,675. ELECTRICAL INSULATORS. F. W. Le Tall. (Westinghouse Electric and Manufacturing Co.) June 10th, 1919. (136,112.)

15,658. SPARKING PLUG. A. Greensmith. June 21st, 1919. (136,115.)

15,921. SPARKING PLUGS FOR EXPLOSION MOTORS. J. Sender. June 24th, 1919. (136,117.)

17,237. SIGNAL SYSTEM FOR TELEPHONES. K. Tsukamoto and Kabushiki Kaisha Tsukamoto Denki Kenkyusho. July 9th, 1919. (136,494.)

17,640. SELECTING DEVICES FOR AUTOMATIC TELEPHONE SYSTEMS. Siemens Bros. & Co., E. A. Petithory and G. P. Sumner. July 14th, 1919. (136,497.)

17,988. ELECTRIC FURNACE CONTROL APPARATUS. H. A. Winne. January 2nd, 1919. (136,500.)

19,086. DISTRIBUTORS FOR MAGNETO GENERATORS. E. C. R. Marks. (Splitdorf Electric Co.) January 31st, 1919. (Divided application on 2,484/19.) (136,124.)

19,720. HORSEHOE MAGNETS. Scintilla. August 29th, 1918. (131,880.)

22,171. TELEPHONE RECEIVERS. E. Hausdorf. September 9th, 1919. (136,511.)

25,924. MEASUREMENT OF ALTERNATING ELECTRIC CURRENT POWER. S. Z. de Ferranti, G. Wall and Ferranti, Ltd. December 21st, 1918. (Divided application on 21,466/18.) (136,515.)

28,567. ELECTRICAL FUSES. Cable Accessories Co., F. H. Reeves, and A. Crawford. December 12th, 1918. (Divided application on 20,686/18.) (136,516.)

Municipal Enterprise in the U.S.A.—The National Electric Light Association *Bulletin* (New York), for December, 1919, gives, among other things, a long list of American municipal undertakings that have had to be closed down as "losing propositions." This seems to indicate that England is not the only hard place for ratepayers and electrical enterprise. The journal also contains an article setting forth the advantages of advertising by means of film cartoons. The author asserts that at least half the population of the average town attends the local kinema shows once a week, and there is, therefore, no better way of securing the public interest in the business.